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Some Real Street Lighting.

The illumination of upper Seventh Avenue, New York City, recently described in these columns, will, we trust, serve as an example to be followed in other cities. It is one of the very few American examples of an adequate amount of illumination well diffused. The amount of energy is, in the first place, very exceptionally large for this country, being about 26 kw per mile. Considering the width of the street, however, which is about 150 ft., it is at once evident that the energy is not at all excessive. It is, in fact, barely enough for the work, using the present type of enclosed lamp, and amounts to only about 0.03 watt per square foot. That the present good illumination is secured so economically is proof enough of the skill with which the available resources were employed. The nature of the street—a wide boulevard with a narrow strip of parkway in the center—suggested the arrangement of the lamps in three rows, one down the parkway and one near each center curve. As a matter of fact, the curb lights have been arranged to take care, as far as may be, of the street intersections, and have been carried on 12-ft. mast-arms well out into the street; and the lamps are in effect arranged in three rows, each row being spaced at about 225 ft. The center row has its lamps in the middle of the blocks, while the lateral ones have theirs near the north and south corners of the blocks respectively.

The equilineal lines produced by this arrangement show good though rather odd-looking distribution, symmetry having been disregarded very properly in order to get better results at the cross streets. The illumination on the sidewalks is also to some degree sacrificed in order to get more light in the driveways. In the street considered, with no small amount of lighting in the bordering shops, this procedure was quite justifiable, as indeed it often is in American cities. The very general shop lighting, kept up till late in the evening and to a certain extent all night, is no mean contribution to the lighting of the street as a whole. In fact, it has been in some places so much a reliance that were the shop lights out, the whole street would be practically in darkness. Using, as in Seventh Avenue, arc lights hung fairly high, there is a very useful amount of light gained by reflection from buildings. It is possible that with arcs hung a little higher and on somewhat shorter mast-arms, this element of the illumination would have been more useful and the lighting of the sidewalks somewhat better. The actual amount of illumination obtained by the arrangement of lamps chosen is far in advance of that usually found in the streets, and the figures are all the more impressive as they are for the horizontal plane instead of being taken normal to the ray. This method of measurement, generally preferable, is in such a case as this imperative, since with three rows of lights their co-operative effect must be considered.

Still more noteworthy are the results when one realizes that they are derived from arcs with diffusing globes. These, of

course, actually cut off a good bit of light, but certainly more than make up for the loss in freedom from shadows and absence of the glare that so often makes a street unpleasant. The working usefulness of the lamps is certainly very greatly increased by this diffusion, and the effect is much more pleasing. The failure of smaller light units than the arcs, whether gas or electric, to give satisfactory results was to be anticipated. In a wide street small units are lost, and unless the street fairly bristles with posts, no striking results can be obtained. Street lighting with small units has often been advocated for economic or theoretical reasons, but the solemn fact is that it does not give the results when it is tried. The chief reason is, of course, that it is an attempt to scamp on energy under one pretext or another. When one measures the illumination in a horizontal plane, every such attempt comes evidently to grief, for the more distant sources practically drop out of sight and the nearer ones, being small, fail to deliver the goods except in a contracted area. The experiments conducted with Welsbach lamps showed very plainly the faults of this or any other plan depending on the use of small units. Where the lighting attempted is on a modest scale, as on side streets, where high intensities are not needed, the smaller lamps can and do give good results, but for the adequate illumination of principal streets there is nothing like electric arcs, big ones and plenty of them. One interesting feature of the recent arc lighting in the metropolis is the special motor tower wagon arranged to do the trimming. When one man is enabled with such assistance to trim 150 or more lamps a day, the burden to such work seems to be greatly reduced. The fact is that people are more scared than hurt in the matter of trimming. In the latter days of open arc lighting in this country, station men had trimming figured down to a fine point, and some have it there yet. Even frequent trimming is better than low efficiency.

The Parallel Operation of Transformers.

It is a striking contrast between direct-current and alternating-current generator units of any kind that when direct-current units are operated in parallel, the share of the total current and the total load which falls to each individual unit, if all generate the same internal e.m.f., is in simple proportion to the conductance of that unit, or inversely as its resistance. If the particular unit considered has a conductance of, say, 1 millimho, and the total conductance of all the units connected to the busbars is 10 millimhos, then that particular unit will deliver one-tenth of the current and carry one-tenth of the total load. If, however, we connect alternating-current units in parallel, the division of the load will not, in general, depend upon the conductance, or resistance reciprocal, of the various individual units, still assuming equal internally generated e.m.fs.

The division will be in direct proportion to the admittance of each unit, which is the same rule as in the direct-current case, only expanded from one-dimensional arithmetic to two-dimensional arithmetic—that is, from simple numbers to vectors. Consequently, in the alternating-current case there will be cross currents, and wattless currents, circulating among the various individual units, which, however necessary in order to vindicate vector arithmetic, are apt to be a puzzle, a bother and a snare to the unsuspecting switchboard attendant if his mind is accustomed only to single-dimension arithmetic. It is true that if all the individual units have the same reactance factor, or ratio of reactance to resistance, the distribution of current and load will be in simple proportion to the conductances, as in the direct-current case; but this equality of reactance-factor in different units is a rule honored more in the breach than in the observance.

Two articles appear in this number on the subject, one by Mr. J. Murray Weed, and the other by Mr. H. Bewlay. Each deals with the matter in its own way; but they have much in common. Perhaps the simplest way of regarding this action of transformers in parallel is to reduce all to their equivalent ideal level transformers, and then to reduce all to equivalent choking coils inserted between the primary and secondary mains, the latter being now supposed to operate at the primary pressure. When a number of different choking coils are connected in multiple to a common load from primary mains, the share of the load carried through each choking coil is manifestly determined, not by the relative conductances, but by the relative admittances or vector conductances, the reciprocals of their respective impedances. This will involve a certain waste of current, or additional cross-current, between the various choking coils, unless their reactance factors happen to be all alike, in which case only the sum of the individual currents will be the same as the total load current.

Experimental Determination of the Hysteretic Exponent.

When iron is subjected to cyclic reversals of magnetization, we know, by much and expensive experience, that the energy invested in it is discounted at every half cycle, and the deficit, expended as heat, is paid for by the source of energy supplying the magnetization. We can picture to ourselves, in accordance with our molecular theory of magnetism, the jostling magnetic cyclic process, with the inevitably induced molecular oscillations and jarrings that fritter away the energy in heat. Every cubic centimeter of the metal, magnetized at the crest of each half wave to a flux density of $\mathfrak{B}$ gausses, involves and demands a capital expenditure of $\mathfrak{B}^2/8\pi$ ergs. In a proper performance of the duty, following the example of air, wood and other non-magnetic substances, each cubic centimeter of iron should pay back this forced loan of energy when the iron next passes through zero magnetization. But the iron wastes and dissipates in hysteresis an appreciable percentage of the loan, and the loss must be smilingly paid up by the source, at the next half wave of magnetization. The exact proportions of the loss which the swinging molecular groups dissipate hysteretically has not yet been computed. The action, although readily conceived of in gross, is too complex in detail to admit of being determined mathematically, although we need not despair of success in this direction. Steinmetz showed, however, nearly 20 years ago, that an empirical exponential relation existed between the hysteretic loss of energy in the cycle and the maximum cyclic flux density. That is, the hysteretically wasted energy $w = \eta \mathfrak{B}^{1.6}$ ergs per c.c. where η is a constant for the particular quality of iron experimented with, and $\mathfrak{B}$ is the maximum cyclic flux density in gausses.

If the exponent in this expression were unity, the relation would mean that doubling the density would double the energy wasted per cycle. If the exponent were 2, the relation would mean that doubling the density would quadruple the energy wasted per cycle. It so happens that the exponent 1.6 means that doubling the density very nearly trebles the energy wasted per cycle. This exponent 1.6 is not a physically fixed constant, as some have supposed. It is only an empirical engineering constant, which meets the experimental facts sufficiently well for ordinary purposes. Sometimes the exponent is as low as 1.4, and at other times, with other specimens of iron, or even at other flux densities in the same specimen of iron, the exponent is as high as 1.8. The exponent is apparently connected with the law of probability of error, and with the average behavior of a crowd. It is part of the mob law of a huge mob of iron molecules. No two definitely unstable molecules, perhaps, behave in exactly the same manner in the cyclic magnetization, but the average behavior of a million definitely unstable molecules is fairly definite, and the average behavior of a million million definitely unstable molecules is almost rigidly definite. The most certain and reliable actions in this our world seem to be the average or general total action of a very large number of definitely unstable entities, be these individual gas particles in the cylinder of an engine or individual metallic particles in a magnet cone or individual human beings in a community.

In the interesting article by Mr. Nicholas Stahl, appearing on page 1122 of this number, it is shown how the hysteretic exponent may be evaluated from four measurements of power, supplied successively to a magnetizing coil containing a core of the iron under test, when two measured voltages are used at each of two defined, but not necessarily measured, frequencies. Care has to be taken in such measurements that the temperature of the iron core is sufficiently nearly constant throughout, because the eddy current loss depends markedly on the temperature, and can only be correctly eliminated from the result by keeping the temperature the same. Moreover, the wattmeter measurements require to be made with considerable care and precision, since a small error in any one of them is capable of introducing a very appreciable error into the exponent thereby computed. We hope that someone will make a careful series of such measures and report the variations in the hysteretic exponent that may be actually encountered in different samples of iron of definitely analyzed chemical and physical qualities.

CALCULATING ILLUMINATION.

Dr. McAllister's suggestion of an absorption-of-light method of obtaining illumination, which appears elsewhere in our columns, is both theoretically and practically interesting. It serves as a useful corollary of the recent convention discussion on the subject of flux-of-light methods. At that time the question was raised as to whether for approximate purposes the summation coefficient $1/(1-k)$ could be successfully used for actual rooms. No definite answer was obtained at the time, though the general impression seemed to favor the negative. The present paper shows how by a cognate method one can form a summation by parts that may lead to useful results. Obviously the trouble with the $1/(1-k)$ plan is that it theoretically applies to a spherical enclosure and that in practical rooms the geometrical form is that of a hollow rectangular prism of which the several surfaces have different and irregular coefficients of reflection. Now, the more perfectly diffusing the walls the less is likely to be the variation from the condition of a spherical surface and it is pertinent to inquire how nearly the experiments reported with the test room uniformly light in color over the whole surface checked with the $1/(1-k)$ theorem. In point of fact, they appear to check more closely than one would at first think, leading to a very plausible value of k, considering that the light surface was far from completely diffusing. When, however, one considers the case of values of k varying widely from place to place, the question becomes much more complex, and just here Dr. McAllister's method comes into play. It is fundamentally similar to the $1/(1-k)$ method since all the light not reflected is the light absorbed, but it lends itself rather readily to summation of the effects by parts, and in this respect should prove of considerable convenience.

Theoretically it is a very good example of the way in which the properties of fluent quantities can be applied to give useful results without reference to the physical properties of the fluents. Of course, if the lighting units applied do not agree with those required by the computation, nothing happens except that the specific illumination is varied, which is all that the conditions of the problem require. No information is given as to the distribution of the total light required, since this is implicitly involved in the assumptions regarding illumination required. This difficulty, however, turns up in one form or another in all methods of calculating illumination. The practical trouble with treating the general problem is that in dealing with concrete cases there is an implied or expressed requirement that within certain bounding surfaces the illumination shall reach a specified value on a certain opaque plane which coincides with none of the surfaces. If the illumination is to be measured as on the surface of this plane, then there are geometrical conditions to be met of which no general flux method takes account.

It would be most interesting and instructive to ascertain how far one could get by trying out various methods of summation by parts, image methods and the like, in determining, for instance, the illumination on the top of a table. One of the most uncomfortable practical problems to deal with is the illumination on the working plane in a large and low room. What is the simplest way of getting at it? The experimental data on the effects of walls, ceiling and floors are of a most intricate character and need very careful analysis to derive any practical conclusions. Dr. McAllister has done good service in calling attention to a convenient way of dealing with heterogeneous surfaces, and further discussion of the subject should be fruitful. It is one of the curious and often most discouraging features of work in illumination that a pathway apparently clear suddenly leads one into a quagmire of abstruse theory. Every attempt, like the one before us, to get at simplified general methods is helpful; and while it may not lead to precise results in special cases it can at least prove useful in showing how to attack some common problems with reasonable probability of success.

Report of Arnold and Young on Chicago Municipal Street Lighting.

A brief telegraphic report appeared in our issue of last week announcing the publication in Chicago of a report made to Mayor Busse on the cost of street lighting by the municipal electric street lighting plant of that city, by Mr. Bion J. Arnold, as engineer, and Mr. Arthur Young, as accountant.

The report sets forth the total moneys expended by the city for its electric lighting plants as shown from the vouchers, together with the present book value of the properties; the cost of lighting as determined from an examination of the vouchers; the replacement value of the property and the present value; an estimate of the cost of lights to the city that may be expected with the plant as now operated, and the cost that may be expected in case a complete alternating-current plant were installed.

For the five years 1903 to 1907 inclusive, the cost per lamp-year is found to be $81.46, considerably more than shown by municipal reports in years past. Of this, $44.42 is cost of production and $37.04 is cost of distribution. During this time light was furnished by the city power plants, some of which contained old types of direct-current generators belted through line shafts to steam engines. Other of the plants contained more modern alternating-current generators direct connected to steam engines.

On July 15, 1907, a contract was entered into between the city and Sanitary District of Chicago providing for the purchase of alternating current from drainage canal water power for city lighting, and alternating-current substations have been provided and connected up for operation with current taken from the Sanitary District substation. The direct-current equipment still retained in the lighting service is now operated by motors driven by Sanitary District current. Approximately 4800 direct-current arc lamps and 4200 alternating-current arc lamps are in use.

The steam plants are kept in readiness, although in normal operation all the power is taken from the Sanitary District. With the system as it is operated at present the estimated cost per lamp-year is $60.56. If the steam plants should be abandoned so that there would be no expense in keeping them ready for emergencies, and if an alternating-current system were used throughout so as to reduce the cost of attendance, the cost per lamp-year is estimated at $42.17. The alternating-current arcs are 7.5 amp—an all night every night schedule being in vogue.

These costs are based on the present contract price for current from the Sanitary District, which is 0.5007 cent per kw-hour when used as the city is using it. The cost of current is only $10.47 per lamp-year and accounts entirely for the low total cost per lamp-year. This price for current is a special price for energy used for municipal purposes made by the Sanitary District to all municipalities that lie within the district which bore the expense of creating the drainage canal water power by which the energy is produced.

The following is the engineer's estimate on cost per lamp per year, using purchased water power entirely and abandoning the steam plants:

Cost to city of electric current from sanitary district	$10.47
Maintenance and repairs, circuits, conduits and lamp posts	2.01
Maintenance and repairs, lamps	1.85
Lamp trimming	4.91
Globes	.71
Carbons	1.59
Ground rent	.19
Wages and salaries, general,	1.76
General expense	.08
Department salaries	.33
Office list	.08
Taxes on distributing system	2.76
Depreciation on distributing system	7.34
Interest on investment	7.55
Insurance on substation buildings and equipment	.52
	$42.17

The annual depreciation rates taken on various parts of the equipment in the estimates of past and present costs were as follows:

Electric power distributing system.

Poles	3.5%
Lamps	6.66%
Circuits	4.0%
Conduits	3.0%

Power plant and substation.

Steam equipment	4.1%
Electrical equipment	4.7%
Buildings	1.08%
Repair shop equipment	10.00%

Chicago Street Lighting.

Mr. William Carroll, city electrician of Chicago, gave a talk at the noonday meeting of the Chicago Electric Club, Nov. 11, in which he made some interesting statements in regard to the electric lighting of Chicago's streets. The city of Chicago has built its street lighting system a little at a time, as it has always been short of funds to properly equip and enlarge its public undertakings with the exception of the waterworks. For the building of the waterworks bonds have been issued, but the city has not the power to issue additional bonds for the complete electric lighting of its streets; consequently, a few lamps have been added at a time.

He stated that at present Chicago has 9165 street arc lamps operated by the city; 674 arc lamps rented from private companies; 10,523 open-flame gas street lamps; 12,102 gas-mantle street lamps, and 7 gasoline-mantle street lamps. A large number of new lamps is being added each year. The present policy is to establish small substations at various centers where room is available. These substation buildings are of steel and concrete construction. They contain a number of tub transformers supplying all the arc lamps in the vicinity, and fed from a transmission line from the power station. One of the most recent substations of this type is at Emerald Avenue. The cost of this substation and the lamps, conduits, poles and complete street lighting system supplied from it was $115 per lamp. The enclosed series-alternating carbon arc lamp is used.

Mr. Carroll expressed the opinion that the figures were substantially correct in the report recently made by Bion J. Arnold and Arthur Young on the probable cost of the city arc lighting in the future when the full use is being made of cheap power from the drainage canal and the steam plants are entirely abandoned. These figures were $42.17 per lamp. Mr. Carroll's figures for this particular new station, representing the best economy, were $38 per lamp per year. Mr. Carroll stated that about Jan. 1, 1909, 12,700 city arc lamps would be in use, and to complete the lighting of the city by electricity 17,000 more would be necessary. This estimate on the amount of money required to equip for the full number of 29,700 lamps, including the cost of changing the old direct-current open arc lamps to a series-alternating system, would be $2,305,000. The only fair way to raise this amount of money would be by a bond issue by which future generations would pay some of the expenses of the present improvements, the benefits of which would be enjoyed in the future. Under present laws the city cannot increase its bonded indebtedness. He appreciated the desirability of increasing the arc-lighting system, but under present conditions it was impossible. He submitted figures to show that although the electric lighting of Chicago is inadequate, other large cities throughout the country are suffering from a like deficiency.

In the discussion which followed he stated that the estimate of 29,700 lamps would provide for a lamp every 250 or 300 ft. in thickly settled streets. In answer to a question as to the percentage allowed for depreciation in his estimate of $38 per lamp per year for the lamps supplied from the latest substation, he said that 1 per cent was allowed on renewals, 2 per cent on conduits, 8 per cent on lamps and 5 per cent on poles yearly.

It seemed to be the sense of the meeting that public agitation of the question of better street lighting would be a good matter for the club to take up. The matter was referred to the civic committee of the club.

Commonwealth Edison Annual Report.

The report of the Commonwealth Edison Company of Chicago for the year ending Sept. 30, 1908, just issued, is interesting to all concerned in the financial condition of electric light and power companies, as it represents what can be accomplished with a large property of this kind having highly perfected business and engineering methods.

The report shows an increase of $658,818, or 7.5 per cent over the combined gross income of the Chicago Edison Company and the Commonwealth Electric Company for the year ended March 31, 1907. Expenses of operation, taxes, etc., amounted during the year ended Sept. 30, 1908, to 67.1 per cent of gross income as compared with similar expenditures aggregating 70.1 per cent of the gross income of the two properties during the previous fiscal year for which returns are available. The net earnings, applicable to dividends last year, after an allowance for depreciation reserve, were equal to 6.19 per cent on the $30,000,000 of capital stock.

BUSINESS SUMMARY.

Gross income from electric current and merchandise sales	$9,500,907
Operating, repairs and renewals, depreciation, taxes and general expense	6,374,578
Net income from all sources	$3,126,329

CHARGES AGAINST INCOME.

Interest on bonds and debentures	$1,032,625	
Depreciation reserve	236,000	
(Under the terms of the mortgages made by the Chicago Edison Company and the Commonwealth Electric Company).		
Dividends paid	1,372,035—	2,640,661
Balance		$485,668

ASSETS.

Plants, real estate, etc	$51,657,050
Unfinished plant investment	318,498
Open accounts	308,589
Material	520,199
Accounts and bills receivable	1,193,933
Cash	1,567,433
Total	$55,565,706

LIABILITIES.

Capital stock		$30,000,000
Bonds and debentures	$21,243,000	
Unsold	500,000—	
Sold and outstanding		20,743,000
Real estate mortgages		220,000
Depreciation reserve		1,794,500
Accounts payable		523,768
Municipal compensation		102,477
Taxes accrued		475,000
Bond interest accrued		264,139
Surplus account		1,442,820
Total		$55,565,706

In making this report President Samuel Insull says:

"The directors herewith submit a report and a condensed balance sheet and income account for the fiscal year ending Sept. 30, 1908. The company came into legal existence and began business on Sept. 17, 1907, through the consolidation of the Chicago Edison Company and the Commonwealth Electric Company, and the net earnings for the period from that date to Sept. 30, 1907, are for convenience included in the surplus brought down on Sept. 30, 1907.

"In opening the books of account of this company your directors thought it advisable to have made a detailed inventory and valuation of the property and business acquired through the consolidation rather than start with the book values of the constituent companies.

"The making of this inventory and valuation was intrusted to H. M. Byllesby & Company, whose exhaustive report has been taken as the basis for the initial investment entries in the company's books.

"The company's connected business, exclusive of electrical energy applied to other public service corporations, amounted to the equivalent of 4,137,650 standard 16-cp lamps on Sept. 30, 1908.

"The company is also supplying electrical energy amounting to approximately 75,000 hp under long-time contracts, running from 5 to 10 years, to street railways and other public service corporations which have found it to their interest to purchase power."

In connection with this report of the company it is interesting to note that the investment in bonds and stock per kilowatt of station capacity (taking the capacity as stated in the comprehensive article in the ELECTRICAL WORLD of May 16, 1908, as 119,250 kw) is $420, which is low for a company of this size. The gross yearly income per kilowatt of capacity is $79. The gross yearly income per $100 invested in bonds and stock is $18.70. If the population of Chicago is taken as 2,425,000 (which is the estimate made by the compiler of the Chicago city directory, based on the ratio of directory names to census population on census years), the gross income per capita of population is $3.90. This, however, includes receipts from power sold to the electric railway companies of Chicago and does not represent simply income from what is ordinarily classed as central-station service. The very fact that the company is able to make long-time contracts with the railway companies at figures which make it inadvisable for the railways to build their own power plants, shows what a strong position a central-station company by far-seeing management may occupy in a community. The low investment per kilowatt is in part due to the fact that there is no distribution system investment (except that in 9000-volt transmission lines) in connection with the station capacity which is used for railway power. This is about half of the total station capacity.

Fitchburg, Mass., Electric Franchise.

The Massachusetts Gas & Electric Light Commission will give a public hearing in the Aldermanic Chamber of the Fitchburg City Hall at 10 a. m., Nov. 23, relative to the appeal of the Fitchburg Gas & Electric Company from decisions of the Board of Aldermen in regard to franchise matters of the Connecticut River Transmission Company. The appeal involves the entrance of a new company for transmitting electricity over considerable distances into the local territory of an established central station, and the settlement of the matter by the commission will afford a precedent of much interest in the central station field of New England.

On Aug. 18, 1908, the Fitchburg Gas & Electric Company filed an appeal with the Gas & Electric Light Commission from the action of the mayor and aldermen, who on July 21, 1908, granted to the Connecticut River Transmission Company the right to erect, maintain and use over certain streets and highways a high-tension line for energy transmission at from 60,000 to 70,000 volts, and a low-tension, 6600-volt line for energy transmission from a substation to be built on Beech Street to or near the property of the Star Worsted Company, the Iver Johnson Arms & Cycle Company, the Parkhill Mill A, the Fitchburg Steam Engine Company and the DeJonge Paper Company.

A franchise was granted to the Connecticut River Company by the aldermen of Fitchburg on Sept. 1, 1908, allowing the above transmission substantially as outlined, with certain provisions, among which were a restriction that the 6600-volt lines on Rollstone, River, Sheldon and Nockege Streets are to be placed underground at such time as the Fitchburg Gas & Electric Company shall place its wires underground, the work of both companies to be done simultaneously; also that the power company shall sell to both small and large consumers on application, and that the company shall not furnish electricity to anyone whose sole object in receiving such electricity is to re-sell the same at a profit to itself, and at a rate higher than it could be furnished by the company directly to consumers.

On Sept. 15 a second petition was filed by the Connecticut River Transmission Company with the Fitchburg Board of Aldermen asking approval of locations for 6600-volt lines on certain additional highways of the city. This petition was granted on Oct. 6, giving among other locations the right to transmit energy to the Leominster line. The Fitchburg Gas & Electric Company appealed to the commission on this second petition Oct. 9, 1908. The two petitions will be heard on Nov. 23.

Investigation of Electrical Corporations in New York City.

The hearings on the investigation of electrical corporations in New York City were resumed by Commissioner Maltbie, of the Public Service Commission, First District, on Nov. 9. Mr. Arthur Williams, director-general of the New York Edison Company, was recalled for further examination.

Commissioner Maltbie referred to the previous discussion regarding the time when a meter that was inaccurate became fast, and whether the change was gradual or sudden. Mr. Williams made it plain that in some instances the change would be sudden and in others gradual. With a gradual change from 0 to 8 per cent, the average percentage of inaccuracy for a period, assuming that the use of current was substantially proportionate over the entire time, would be about 4 per cent. With the larger part of the consumption nearer the zero line during the period, the larger part of the current consumed would have been recorded with a smaller average of error than 4 per cent.

Commissioner Maltbie stated that the percentage of error would not be changed by the amount of current consumed, but there would be a change in the amount of the error or the amount of injury done the consumer.

Mr. Williams thought that both would be changed. Assuming that the meter had been calibrated in December and that in that month it immediately commenced to run fast, starting from 0 and reaching 8 per cent, say, eight months later, the larger part of the current consumed by the customer would be in the winter months when the error was beginning with zero, and the smaller consumption would be at the end of the period where the error was relatively large in percentage. Mr. Williams did not believe that in ordinary practice the overcharge would reach 8 per cent month by month without serious complaint on the part of the consumer. He thought that the gradual increase did not reach the larger percentages. While a customer might not notice that the bill for one month was 5 per cent high, with a continuation of an addition of 3, 4, 5 or 6 per cent increase, he would notice that the tendency was upward. In a vast majority of cases the tendency would be observed and complaint would be made long before a large percentage had been reached and repeated month after month.

The company has approximately 10,000 to 12,000 complaints annually at the present time; some are repeated complaints. It has now nearly 70,000 consumers, but about 86,000 meters. The meter is sometimes responsible solely for the complaint. As a certain number of customers receive weekly bills, their complaints would give four or five times the number per customer that would be returned by the normal customer on the monthly basis. The company issues 1,200,000 bills a year, indicating that complaint is made of about 1 per cent of the bills rendered. This percentage, however, really overstated the number of original complaints, because if a customer, for example, is not satisfied regarding the result of a test or explanation by the company, another complaint is issued on his account. Perusal of the list of complaints would show that a certain proportion came from chronic objectors.

The subject of tests was taken up and, in responding to an inquiry, Mr. Williams said that few periodic tests show an error as large as 10 per cent, a figure cited by Commissioner Maltbie. After investigation of many complaints, it was found that the meter was slow. The vast majority of complaints, probably between 80 and 90 per cent, were made when no mistake on the part of the company had taken place. The company, however, assumed that the complaints were made in good faith. Large percentages of error did not occur very often, and Mr. Williams was of the opinion, without attempting to say that the rule applied in every case, that a material error in the meter was followed almost immediately by complaint on the part of the customer. The meter was retested on complaint, unless a test had taken place recently by which the accuracy of the meter could be judged. The original time distance of a nearby test in these cases was three months, but present practice is about a month or six weeks.

If the periodic test had been made within a month or six weeks before the complaint was received, a new test would not be made ordinarily unless the customer requested it or some special reason existed why it should be made. The result of the periodic test was taken and the rebate was based upon any error it might have shown. The rebate was given as far back as might seem fair to the consumer; it might be three or four months, or even longer. The normal practice in treating customers was to assume that the error occurred at the time the complaint was made. The company deviated from that practice to any extent that might seem necessary or desirable after investigation, in the endeavor to treat the customer with absolute fairness and because of the desire that no meter error should be the cause of a permanent dissatisfaction on the part of the consumer. In probably over, rather than under, 90 per cent of the cases new complaint tests were made. It was estimated that not over about 20 per cent of those who complained asked specifically for a test.

Replying to a question, H. M. Edwards, auditor, New York Edison Company, said he could prepare a statement showing the payments to consumers in 1907 in the form of rebates resulting from adjustments of meters. Mr. Edwards would be very much surprised if the amount was as much as $10,000 out of a total business of $14,000,000.

Mr. Williams said that with very few exceptions the company had never asked the payment of damages on account of injury done to a meter. During several years he thought there had been only half a dozen cases where the consumer had been asked to pay for a damaged meter.

J. W. Lieb, Jr., associate general manager, New York Edison Company, was recalled for further examination. He said that if the commission, after considering the question, deemed it desirable to standardize meter practice in the district in the adjustment of claims based on complaints where the meter was found to be fast, and if the commission deemed it desirable that the adjustment should be made on the basis that an allowance be given to the customer extending back over half the period since the last previous test, the company would be prepared to carry out a suggestion in that direction. He would add, however, that in exceptional cases where it was proved clearly that the customer was entitled to an allowance extending over a longer period it should be possible to extend the allowance accordingly. Should the facts show clearly, however, that the customer was not entitled to one-half the period, the allowance period should be modified accordingly. Departures from the standard practice could be based upon demonstrable facts and any allowance based upon them could be subject to review by the commission in case any question should arise.

Commissioner Maltbie asked what the company did to prevent and discover tampering with meters and also regarding the various means of getting current without paying for it.

Mr. Lieb said that the meter testers, inspectors and meter readers were instructed to report at once anything unusual which they might find. A special branch, on receiving notice that some irregularity had been found, sent a representative to the premises to make a detailed inspection and investigation. If advisable, special experts might be sent also. If the conditions indicated plainly that an attempt had been made to deprive the company of revenue or to interfere with the meter, the proprietor was invited to observe the conditions. In accordance with the suggestion made by the commission some time ago, a card was usually left with the customer in such cases, explaining the facts and asking him to see the representative of this special department. In the meanwhile, the inspection department was notified and a report was made stating (which was likely to be the fact) that the customer had been cut off. After the customer saw the representative of the special department and the inspection department, the history of the installation was gone over and the customer was requested to pay an amount which it was estimated would reim-

burse the company for the energy for which it had not received payment. After such estimate had been prepared, the customer was asked to sign a paper stating that he had made the payment in adjustment, and when he had done that and reimbursed the company, the premises were reconnected as a general rule. Careful watch had to be kept of some customers. To take any action under the statute it was necessary to catch an individual in the act of wrong-doing.

Commissioner Maltbie said it had been shown that non-payment of bills and tampering with meters were causes for cutting off current. He asked if any other causes led to similar action.

Mr. Lieb said that if the condition of the installation might invalidate insurance policies the supply might be cut off after the situation had been explained. Similar action might be taken if the customer might be found to have introduced any practice in his installation which would be considered a violation of the operating rules of the company and would interfere with supply or service at neighboring premises.

Inyestigation of Cost of Street Lighting in New York City.

New York City has retained Austen G. Fox as special counsel in an investigation of the cost of street lighting, and application has been made to the courts for an order to permit the city to inspect all books that will show the cost to the companies of electric lighting. The city also wants to inspect the plants and machinery of the companies, and, in fact, to investigate every part of their plants, books, bills or receipts that will give an idea of how much it costs to make and distribute electric power. Mr. Fox said there were more than 150 different items in the companies' offices that the city wanted to inspect.

This motion was brought about by a suit began by the New York Edison Company to recover about $500,000 from the city for electric light furnished in 1903 at $146 a lamp. The city asserts the price was excessive, while the company officials allege they have a contract at that rate. The rate now made by legislative action is $100 a lamp. H. J. Hemmens, counsel for the electric companies, opposed the granting of the application and said if the city and the companies had a contract there was no reason for the motion. He added that the city had not shown the electric companies were in possession of the information desired. He said the original action was brought in 1902, and that now there was not a single station that was then in operation and that the entire system was different. Now all the power is generated at First Avenue and Thirty-ninth Street, sent to different sub-stations and distributed throughout the city.

Decision on the motion was reserved.

Decision Against Municipal Ownership at New Bedford, Mass.

A joint special committee of the New Bedford city government, appointed for the purpose of investigating municipal ownership of the electric lighting plant, has reported adversely to the project. This committee had three matters to investigate: First, the desirability of a municipal lighting plant for New Bedford; second, to ascertain the cost to the city to acquire by purchase, by construction, and by lease, the plant for the manufacture and distribution of gas and electricity for furnishing light for municipal use, and light, heat and power for the use of the inhabitants; third, to ascertain the annual cost of maintaining such a plant.

The committee reported that it does not think it desirable under the present law, Chapter 34, Revised Laws of Massachusetts, to enter into the municipal lighting field. The laws of this State are very carefully drawn with regard to municipal competition with established plants, and tend to protect the latter against hasty or ill-considered action for political or destructive purposes. Municipal plants are not allowed to construct, purchase, or lease stations for supplying energy for electric car operation; and plants acquired for municipal lighting are not authorized except by a two-thirds vote of each branch of the city council passed in each of two consecutive municipal years, and thereafter ratified by a majority of the voters at an annual or special city election. If such a vote is not ratified, no similar vote can be submitted for ratification for at least one year afterward, and such a vote of the city council is subject to the approval or veto of the mayor.

In the case of a town a plant cannot be acquired until the purchase has been authorized by two-thirds of the voters at each of two town meetings called for the purpose and held at intervals of not less than two nor more than 13 months. A lapse of two years, at least, must pass if the vote fails, before any similar action can be again attempted. The law is also strict in providing for the purchase of existing plants, the methods of raising money for establishing a plant, jurisdiction of the Gas and Electric Light Commission, appropriations for running and fixed expenses, depreciation fund for renewals other than ordinary repairs, extensions, reconstructions, enlargements and additions, allowable rates to be charged for gas and electricity, assessments, accounting, returns, etc., are equally in force for municipalities.

Assessment of Light and Power Companies in Wisconsin for 1908.

The values fixed by the Wisconsin State Board of Assessment on the property of light, power and street railway companies throughout the State have been finally determined. Of the total tax for each company 15 per cent is retained by the State and 85 per cent is distributed to the towns, cities and villages through which the company operates. The following table gives the official preliminary assessment, the final assessment, the total tax, the portion of the tax retained by the State and the portion paid to the cities, towns and villages of the light and power companies of the State for the year 1908:

Name of company.	Preliminary assessment.	Final assessment.	Total tax.	15% retained by State.	85% for distribution to towns, cities and villages.
Ashland L., P. & St. Ry. Co..	$140,000	$130,000	$1,497	$224	$1,272
Chippewa Val. Ry., L. & P. Co.	750,000	590,000	6,792	1,019	5,773
Eastern Wis. Ry. & L. Co....	750,000	630,000	7,253	1,088	6,165
Menominee & Marinette L. & Tr. Co.	230,000	215,000	2,475	371	2,104
Merrill Ry. & Lighting Co....	180,000	110,000	1,266	190	1,076
Milwaukee Elec. Ry. & L. Co.	22,000,000	21,250,000	244,638	36,696	207,942
Milwaukee L., H. & Tr. Co..	5,200,000	4,900,000	56,410	8,461	47,949
Sheboygan L., P. & Ry. Co..	650,000	610,000	7,023	1,053	5,969
Twin City General Electric Co.	60,000	40,000	460	69	391
Waupaca Elec. Light & Ry. Co.	85,000	80,000	921	138	783
Wisconsin Tr., L., H. & P. Co.	1,025,000	900,000	10,361	1,554	8,807

Library Illumination.

The New York section of the Illuminating Engineering Society held its November meeting at the St. Gabriel's Park branch of the Carnegie Libraries on the twelfth of the month, at which time the lighting equipment and the illumination were explained by Mr. L. B. Marks, consulting illuminating engineer for the New York Carnegie Libraries. Among the special features shown were lighting units which afford proper illumination for inspecting the titles of books on any shelf, from the highest to the lowest. The library is equipped for the minimum required amount of general illumination, and lamps with reflectors are arranged to produce extra light where needed for special purposes. Incandescent lamps are used throughout. In no case is a bare filament placed in the line of vision. In positions where the lamp is exposed to view, frosted bulbs are used. Most of the lamps are completely hidden within the reflectors. In order to eliminate all glare, green coverings are provided for the reflectors even when they are of the prismatic type.

The lighting features were fully discussed by the members, all of whom consider that an ideal illumination had been obtained, the only objection in relation to the equipment being the large number of lighting units required.

Electric Hoists for Construction Work.

The use of electric hoists in construction work is being developed very rapidly by the New York Edison Company. Recently it closed a contract for 1000 hp of electric energy to be used in the construction of the great apartment house being built upon the block from Eighty-sixth to Eighty-seventh Street and Broadway and Amsterdam Avenue in New York City. This building is being put up by the Astors, and it is claimed will be the largest and most complete apartment house in the world. The George A. Fuller Company, the contractor, will use 20 electric hoists for this work and has ordered 200 arc lamps. In addition there will be pumps and some minor hoists for the underground work. Another contract of this character which the New York Edison Company has recently taken is to furnish 450 hp for the caisson work in connection with the new Emigrant Savings Bank Building on Chambers Street, New York. The use of electric current in connection with air compressors for caisson work is somewhat new, many contractors having been afraid of what might happen should the circuit be broken. In a number of important jobs in New York, however, the New York Edison Company has furnished current for this kind of work and no accident has ever occurred. To show how rapidly this class of work is growing, the Edison company sold for construction work 555 hp during October, while in the first 10 days of November it sold for the same purpose 1425 hp.

Corona on Transmission Lines.

Mr. Lamar Lyndon presented a paper before the Philadelphia Section of the American Institute of Electrical Engineers entitled "The Corona Effect and Its Influence on the Design of High-Tension Transmission Lines." The author discussed fully the experimental results obtained by Prof. H. J. Ryan and by Mr. Ralph D. Mershon, and the investigations of Dr. C. P. Steinmetz.

The experiments made by Mr. Mershon indicated critical voltage of about 60 per cent of the values obtained by means of formulas developed by Prof. Ryan. The author stated that it is difficult to assign a reason for the discrepancy between the results obtained by Mr. Mershon at Niagara and Prof. Ryan at Ithaca. The two localities are not far distant from each other, their atmospheric conditions are very similar and both experimenters conducted their investigations with care and in the full knowledge of the art.

While the conflicting data leave one somewhat in the dark as to the definite conditions under which the corona appears and losses begin to take place, a few important facts stand forth prominently and clearly point to the voltage limitations of transmission lines, as follows:

1. The critical voltage is dependent on the diameter of the conductors, their distance apart and atmospheric conditions, increasing with both diameter and separation of the conductors.

2. After the critical voltage is reached the losses increase very rapidly with increase in e.m.f.

3. The critical voltage and the magnitude of the losses, after this voltage is reached, are affected by atmospheric conditions, and therefore the critical voltage varies with the locality and season of the year.

4. In the same section of country, an e.m.f. which is normally below the critical point may be at times above the critical voltage with changes in weather conditions.

5. Smoke, fog, moisture or floating particles increase the losses, while the effect of rain is inappreciable.

6. With increase in separation of conductors the regulation and power factor are diminished.

7. A separation of 10 ft. between wires is as great as is commercial or desirable.

8. The same law applies to cables as to solid wires, the diameter of the cable being the effective diameter of the conductor.

9. The losses appear to be independent of the material of which the conductors are composed.

10. The losses and the critical voltage appear to decrease slightly with the frequency.

11. A transmission line should be designed for the atmospheric conditions obtaining in the locality through which it passes.

12. All corona formation and losses depend on the maximum value of the voltage waves. Therefore, the ratio of the maximum to the mean value should be definitely known to design a transmission system properly.

13. The limiting e.m.f. (effective) which may be applied to a circuit of No. 0 wires, 7 ft. apart, with a maximum vapor product of 0.40, and keep down the line loss due to the corona within 3 kw per mile, is approximately 110,000 volts.

14. In high-tension transmission systems working under potentials exceeding 150,000 volts the wires should be covered with some insulating material having a greater dielectric strength than air, or use conductors of abnormally great diameter.

Electric Heating.

At the meeting of the American Institute of Electrical Engineers held on Nov. 13, a paper was presented by Mr. W. S. Hadaway, Jr., entitled "Electric Heating." The author stated that electric heating may be divided into two general classes, which may be designated as low-temperature heating and high-temperature heating. The first class includes heating of large volumes, while in the second class the heating is generally localized and in small quantity. He said that for room-heating apparatus, one can estimate that 1 watt will heat 1 sq. ft. of common radiator service through 1.26 deg. Fahr. As a basis of comparison with steam-heating, the author assumed the cost of the kw-hour as 6.7 cents and the cost of one steam-heating unit as 40 cents. On this basis, 40 cents paid for steam-heating would purchase 1,110,000 lb.-Fahr. units, while the same amount paid for electric heating would purchase only 20,400 lb.-Fahr. units, the ratio being practically 50 to 1. It would seem, therefore, that the steam-driven electric generating station ranks low as a heat distributor for house warming on any considerable scale. However, notwithstanding the great disparity in the cost of heat energy as obtained directly from steam and electricity the uses to which small electric air heaters are put are surprisingly numerous. The electric air heater is particularly useful in intermittent service when employed on a comparatively small scale. It has been found by experience that the electric auxiliary air-heater for the bath and dressing-rooms, for the libraries, cabins on yachts and steamships in mild climate in early morning and evening, etc., serves its purpose with fair economy, and without the vitiation of the air always evident from gas.

The author stated that for house warming the cost of the electrical hp-year must not exceed $6 in order to compete directly with high-grade coal at $5 per ton.

In domestic work there have been large numbers of household conveniences sold, notably electric sad-irons. Perhaps novelty was in many cases the reason for first purchase and use, but once used the value of the method of heating is well appreciated and extensions are made to more and different work. In this slow and conservative way electric heating in households is progressing, and there are indications of a more rapid general reception and use.

There are some installations in which all or nearly all the cooking is done by electricity. These are generally successful and economical, according to the degree to which extensive water heating is eliminated. Laundry and pressing irons are found almost uniformly satisfactory. Some of the devices used in the dining room are counted great conveniences when electrically heated. When it comes to the kitchen the same feeling of cleanliness and refinement of methods as for the dining room is expressed and hoped for, but the housewife is not so ultimately in contact with the apparatus and ignorant manipulation is encountered, which, however, generally does no other harm than to add to the expense of running. However, fortu-

nately the manipulation and control of the devices are so simple and save the servant so much work that an honest effort is usually evidenced to use it economically.

In industrial work the progress of electric heating has been more rapid than in domestic applications, with the exception of the electric sad-iron. There are cases where heating by electricity is found cheaper than by fuels, setting aside all collateral advantages. In electric cars the more equable distribution of heat on a satisfactory basis of effective warming is sufficient to justify the employment of the method and apparatus, even at considerably greater cost than by former methods of heating.

There is need for research work in materials and processes for good commercial work. The heaters on the market to-day are greatly improved over the product of 15 years ago, but there are still wide gaps to be filled. Localization of heat at high temperatures with negligible heat capacity are the prime requisites of an electric heater. Without adequate heat insulation, with resistance material of comparatively low specific resistance and operating at the high voltages in commercial practice, the average design is far removed from the ideal.

A written communication was received from Mr. C. E. Waddell in discussion of the paper. Mr. Waddell claimed that in high-temperature problems the cost of electrical energy has little or no bearing on economy. On account of its low efficiency the steam-engine electric generating system is debarred from furnishing electric heat in competition with fuel. However, energy obtained from hydro-electric stations can be obtained at values closely competitive with fuels. Of the quantity of heat annually radiated in domestic installations, the greater portion is wasted. It will be necessary to accord to the art of heating and ventilation more scientific attention than is now usually bestowed upon this class of work.

Mr. W. N. Ryerson, in a written communication, related the experiences of the Ontario Power Company with electric heating devices at Niagara Falls. A heater consuming 85 kw has proved adequate for heating a building containing 72,000 cu. ft. of air space and exposed on three sides. The operation of this heater eliminates the expense for wages and gas for a steam-heating plant. The company possesses a complete electric kitchen capable of cooking a meal for 300 persons, which has been used with marked success on several occasions.

Mr. W. S. Andrews remarked that for the past few years electricity has been employed for cooking purposes during the summer months, the cost being $4.50 per month for three meals for four persons, and for operating an electric iron. Electricity is sold at 5 cents per kw-hour. The cost of operating the oven is 9 cents per hour, about one-half hour being required for obtaining a proper cooking temperature. The broiler, which consumes 1.2 kw, cooks a 1.5-lb. steak in 15 minutes. A bread toaster and a coffee percolator combined use 1200 watts; about one minute, at a cost of 10 cents, is required for toasting bread or making coffee. In industrial applications there are many cases where electric heat can be used to great advantage, because it can be localized and controlled.

Mr. James I. Ayer expressed his disagreement with the author's treatment, which seemed to imply that the methods of heating now available are almost hopelessly inefficient, and that real success depends upon the possibilities of the future and not on the certainties of the present. He said that in New York City alone for several years more than $100,000 has been spent annually in the purchase of small domestic electrical appliances.

Mr. Paul M. Lincoln stated that in the application of the heat to any particular work at hand electric heating is decidedly advantageous and is much better than any of its competitors. In many instances this advantage is alone sufficient to overcome the natural disadvantage of low efficiency.

Mr. H. P. Ball expressed the opinion that high-temperature applications are where electric heat can well be employed at the present time, while the distribution of heat over wide areas is a development for the future.

Mr. Max Loewenthal called attention to the fact that with electric energy at 2.5 cents per kw-hour the cost of domestic cooking operations with electricity will be the same as gas cooking with gas at $1 per 1000 cu. ft. For ordinary, average conditions it is safe to estimate 2 watts per cubic foot of space to be heated in room warming.

Dr. C. P. Steinmetz said that the usual assumption that the kw-hour represents a certain definite number of heat units is incorrect; the kw-hour contains a definite number of units of heat energy, but units of heat energy are not necessarily units of heat. In dealing with these two units it is necessary to distinguish between the quantity component and the intensity component, the former being analogous to amperes and the latter to volts. By properly applying electrical energy, and reversing the cycle of the thermodynamic engine, it is possible to reproduce the same heat quantity originally obtained from the combustion of coal. A thermodynamic cycle which yields 5 per cent mechanical efficiency by the ordinary process of receiving high-temperature energy and exhausting at low temperature will yield a 2000 per cent output when reversed to obtain a high-temperature discharge. In the latter case, 95 per cent of the input is obtained at atmospheric temperature, 5 per cent is added as mechanical energy and 100 per cent is delivered at high temperature. In this manner it is possible to produce units of heat quantity at moderately elevated temperature far in excess of the number of units of heat energy corresponding to the mechanical energy input. It is evident, therefore, that the same apparatus could be used to cool a house in the summer time and to heat the house in the winter time by transferring heat quantities from one temperature to another.

Storage Battery Discussion in Boston.

A meeting to discuss the application of the storage battery to electric vehicle service was held at the Massachusetts Institute of Technology, Boston, on the evening of Nov. 12, at which a large number of central-station and automobile experts were present. The meeting was called to order by Mr. Frank J. Stone, manager of the Boston office of the Electric Storage Battery Company, who stated that while the object of the gathering was ostensibly for a discussion of the care and operation of the Exide battery, it was hoped that the cause of the motor vehicle and the central station would be benefited thereby. Mr. Stone pointed out that within the past year or two renewed activity has been apparent in the electric vehicle field, and the importance of this service to the central station is coming to be better appreciated. The vehicle maker is now putting out apparatus of a highly efficient nature, the current consumption of the present equipment being in some cases half that of the earlier types. With the improvement in the vehicle there appear improvements in its method of application. The vehicle engineer, who should at the same time be a transportation engineer, will now make a study of each situation that arises, with a view to determining the character of the load and the best method applicable to its care and distribution. The electric vehicle has a load factor as well as the power station. It is safe to say that in time the horse will disappear from city streets as completely as have overhead telephone and telegraph wires. Mr. Stone then referred to the field open to the central station in encouraging electric vehicle development. The apparent indifference of many central station men to this field indicates that they do not all appreciate the opportunities for profitable sale of current at hours when other demands upon the plant are low. Mr. Stone suggested that central-station managers who have not taken up the electric vehicle problem should look over the field in each case, find a possible customer among their patrons who is open to conviction as to the practicability of the motor vehicle, and call in the vehicle manufacturer for investigation and report, to be followed by a proposition covering the application of the electric vehicle to that particular situation. The evidence that the vehicle manufacturer can produce in connection with his report pertaining to successful operation, the saving effected, and his method of

arriving at his figures, will, in a suitable situation, create an infectious enthusiasm in the mind of the central-station man. Here is work of a most promising nature for the solicitor, and work on which he can be actively engaged without delay.

A paper was then read by Mr. Bruce Ford, Chief of the Department of Development and Design of the Electric Storage Battery Company, Philadelphia, on the "Principles of Operation and the Care of the Exide Battery," with special reference to automobile service. Mr. Ford presented an exhaustive discussion of the construction, rating, testing, operation and maintenance of this type of cell, explained the action of the plates and electrolyte in service, and showed lantern slides of plates which had been treated in different ways, illustrating the limits of wear allowable, the possibility of plate reconstruction, the best methods of charge and discharge, effect of irregular charging and discharging, relations between service and life, and considerations affecting capacity. He stated that the life of the plate is in general proportional to the number of discharges, but under hard usage there may be only 200 discharges secured, while an easier service will perhaps allow 350 discharges. It is very important that the battery be cleaned before the sediment reaches the bottoms of the plates, as this causes loss of discharge capacity, due to local currents. The specific gravity test is the best means of determining the condition of a battery.

CURRENT NEWS AND NOTES.

NOBEL PRIZE FOR MARCONI.—It is unofficially stated that the next Nobel prize in physics will be awarded to Marconi.

WIRELESS TELEPHONY.—According to a dispatch from Rome, Professor Maiorana has succeeded in his tests of wireless telephony between Rome and Magdalena Island, Sardinia, a distance of 250 miles.

PAY-AS-YOU-ENTER.—The pay-as-you-enter type of car is making its way in the great cities. In New York, where it is already in extensive use, 150 have been ordered for use on the Third Avenue line, which is being gradually brought out of the disrepair and disrepute into which it had fallen before the days of Receiver Whitridge.

CITY TIME.—It had been proposed to give the big new police headquarters in New York City a central clock for its tower with synchronized clocks all over the building, at a cost of $15,000, but this plan has been overruled by the Board of Estimate, which does not seem to place much importance on punctuality in municipal offices.

WIRELESS TELEPHONE LITIGATION.—The Radio-Telephone Company, with which Dr. Lee De Forest is connected, has applied for an injunction in New Jersey against the Collins Wireless Telephone Company, to restrain it from alleged infringement of patents granted to John Stone, of Boston, and owned by the former.

CLEVELAND CARS.—The electric street railway system, of Cleveland, as the final result of the three-cent fare régime inaugurated by Mayor Johnson under a system of municipal lease, has now passed into the hands of three receivers. It is hoped that at no distant date it will revert to its owners, the stockholders, with a reasonable schedule allowed for fares.

MEETING OF TELEPHONE MEN.—A convention of representatives of the Cumberland Telephone Company and allied companies was held at Evansville, Ind., Nov. 12. Over 100 telephone managers, superintendents and operators connected with the Cumberland system from southern Illinois, eastern Kentucky and southern Indiana towns and cities were present. The object of the convention was to discuss practical telephone questions, improvements in the service, the newest methods in construction and maintenance, the latest and most effective rules on operating, and kindred subjects.

ELECTRICAL EXPOSITION AT LOUISVILLE.—The Commercial Club, of Louisville, Ky., is organizing an exposition to be held in April, 1909, to be known as the Southern Electrical and Industrial Exposition. A central feature is to have an electrical display not only in the exposition, but throughout the city that will attract the attention of the whole country to Louisville.

OHIO ENGINEERS.—The Ohio Society of Mechanical, Electrical and Steam Engineers will hold its annual meeting at the Hotel Secor, Toledo, Nov. 20 and 21, when an excellent program will be discussed. Among the papers are one on "The Columbus Municipal Lighting Plant" by its superintendent, Mr. G. H. Gamper; and one on "The New Laboratories of the Electrical Engineering Department of the Ohio State University" by Prof. F. C. Caldwell. President Ballard will discuss "The Future Problems of the Engineer." Mr. David Gaehr, Cleveland, Ohio, is secretary of the society.

CHICAGO LIGHTING.—A special dispatch was published in these pages last week from Chicago stating that the report of the engineers on the arc lamps served by the municipal plant showed the cost for the past five years to be $81 per lamp annually, which figure was much "below" that given in the municipal reports covering those years. As the context showed, there was an error in transmission and the word should have been "above." The advocates of municipal lighting in Chicago have vigorously claimed a cost of only $52 per lamp per year, and their figures have been cited all over the country during municipal-plant agitations. An abstract of the Engineers' report is printed on another page in this issue.

A. S. M. E. ANNUAL MEETING.—The annual meeting of the American Society of Mechanical Engineers will be held at the Engineering Societies Building, New York, Dec. 1-4, when a most interesting and comprehensive program has been provided. Special attention will be paid this year to the important subject of aeronautics, by Major Geo. O. Squier, Acting Chief Signal Officer, U. S. A., and Lieut. Frank P. Lahm, of the Signal Corps, the latter delivering an illustrated lecture on the subject on Dec. 2, at 8.15 p. m. The usual reception will be given on Thursday evening. President Holman will deliver an address on Tuesday evening on "The Conservation Idea as Applied to the Society." The professional papers include several on steam and gas engine practice, and one by Norman Litchfield on electric railway gears.

NEW HEAD OF "TECH."—It is announced that Professor Richard C. MacLaurin, head of the physics department of Columbia University, has been appointed president of the Massachusetts Institute of Technology by the executive committee of the institute corporation. He will assume the duties of the office as soon as his engagements at Columbia will permit. Professor MacLaurin will succeed Dr. Henry S. Pritchett, who resigned the presidency of the institute in January, 1906, but remained in office until June, 1907, when he retired to assume the chairmanship of the Carnegie Foundation. Since that time Dr. Arthur A. Noyes has been acting president. Professor MacLaurin was born in Edinburgh, Scotland, in 1870. He entered the University of Cambridge in 1892, received the degree of B.A. and in 1896 the degree of M.A. In Cambridge he was a foundation scholar of St. John's College. He was appointed professor of mathematics at the University of New Zealand in 1898. It was while holding that office that he accepted the chair of mathematics and physics at Columbia University. Since Dr. Pritchett's resignation several well-known educators have been named in connection with the "Tech" presidency.

Hydro-Electric Station of the Cataguazes (Brazil) Light & Power Company.

THERE has just been completed and put into operation in the State of Minas Geraes, in Brazil, a hydro-electric plant which marks a decided step in the advancement of electricity in that country. The generating station embodies no novel ideas in its design or construction and is equipped with purely standard apparatus, yet it typifies more distinctly than any existing installation that country's particular field of commercial application of electricity and embodies several interesting non-technical features. The State of Minas (minas being the Portuguese name for mines) contains what are, so far as present knowledge goes, the richest mineral deposits of Brazil. For over 400 years gold mines have been worked practically all over the State, and diamond mining is only slightly less ancient. In the work so far accomplished, electricity has just lately begun to take its important place, and once the value of cheap hydro-electric power has become appreciated and the railroads to the interior spread out to open up these regions, great developments may be expected in the electrolytic reduction of ores—principally iron ore, in which this part of Brazil abounds. It does not seem improbable, to one familiar with the district, that it is destined to become as flourishing a mining center as Mexico is to-day. In this locality the Cataguazes Light & Power Company was formed and its generating station built.

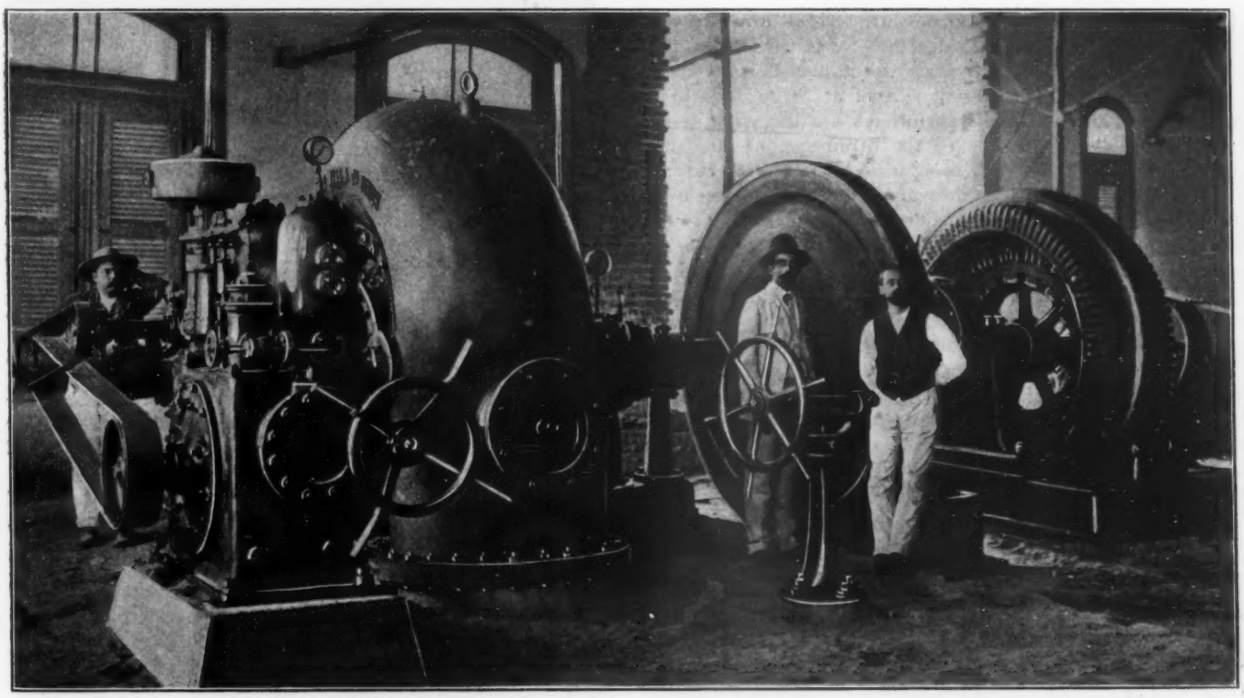


FIG. 1.—INTERIOR OF POWER HOUSE SHOWING ONE GENERATING SET.

The plant as originally outlined comprised a transmission system of 100 miles of 22,000-volt line for supplying energy to four inland cities, and possibly to some of the outlying "fazendas," or plantations. Owing, however, to the facility of extending the high-tension network once it had been spread out over so large an area, and because of the fact that oil lamps and candles were the only available means of illumination in these places, the plans were later extended to embrace two other towns. This made the length of the transmission lines approximately 150 miles.

The existing plant comprises a hydro-electric generating station situated at the foot of a long chain of rapids on the River Novo, almost equidistant from the several cities supplied with electricity. These cities are Cataguazes, with 6000 inhabitants; Leopoldina, with 4000; Rio Novo, with 2000; Sao Joao, with 2000; Rio Branco, with 4000, and Ubá, with 2000. Each of these places has from 150 to 200 32-cp incandescent street lamps distributed through its municipal confines, together with occasional arc lamps in square and parks.

There was also contemplated at the outset a fairly remunerative private load of both lamps and motors. To a foreign engineer, however, visiting the interior of Brazil for the first time, the immediate impression is a prevailing doubt of the ability of communities composed almost entirely of bareheaded, barefooted, uneducated soil toilers to produce a paying central station load. Yet in practically every instance the many small plants throughout the interior are financed by local capitalists or by city bankers and commercial houses familiar with local conditions, indicating a certain amount of confidence in such enterprises, at least among Brazilians themselves. In the Cataguazes Light & Power Company's territory a splendid showing has been made in the acquisition of a commercial load, the installations varying from a few pendants in a corner "venda" store to 150 hp of induction motors in a small cotton mill supplying local trade, and already the load factor of the central station is very near unity. Energy for private consumption is sold at 12 cents (gold) per kw-hour for lamp circuits, and 4½ to 8 cents per kw-hour for motor circuits. The public lighting is contracted for in the municipal concessions, which stipulate a uniform rate of $2.25 per lamp-year for incandescents and $8.10 per lamp-year for arcs.

The falls upon which the Cataguazes development is located are capable of producing 25,000 hp with comparatively little work over what has been done, should the occasion ever arise where it would be possible to employ so much power. The ultimate output of this plant will probably not exceed 2000 kw, however, as waterfalls are so plentiful in these parts of Brazil that a very large customer outside of the cities would doubtless find it cheaper to construct his own plant than to buy energy from a pre-established company.

In the development of this water power the River Novó was bridged about a quarter of a mile upstream with a flush dam of the Wegman type capable of diverting enough water during the dry season to develop the maximum amount of power needed. Such a design of structure leaves the river practically unobstructed to the voluminous and rapidly rising floods of

the rainy seasons. The water thus diverted passes through racks into a long canal blasted out of the rocky banks, where, slowed down greatly in velocity, it deposits its sand and other foreign matter held in suspension and enters the intake gates to the pipe line. This pipe line consists of two steel tubes, each of which is 6 ft. 5 in. in diameter and 840 ft. long. The tubes also occupy a ledge on the bank blasted out of the virgin rock, and, for a distance of 100 ft. before entering the power house, pass through a tunnel which required eight months to excavate. The pipes were built by the Riter-Conley Company of ½-in. steel plates and were erected by local contractors.

The turbines, which are of the radial inward-flow, reaction type, operate under a head of 30 meters (99 ft.), not including the draft-tube, and were manufactured by Escher, Wyss & Company, of Zurich, having been selected because of the high repute which this firm's machinery enjoys among Brazilian engineers. The turbines and their governors, which are also of Escher-Wyss manufacture, were installed by native Brazilian mechanics, several of whom had served apprenticeships at the Baldwin Locomotive Works.

The electrical equipment in the head works comprises two 400-kw alternators of the revolving-field type, generating three-phase, 50-cycle current at 2200 volts. These generators are separately excited from individual belt-connected exciter dynamos. There are four three-phase, oil-insulated, water-cooled, step-up transformers delivering current at 22,000 volts to the transmission lines. These transformers are located in a fireproof room along the side of the turbine room, the entire building, including the floors, being made of reinforced concrete. The electrical connections throughout the entire system are three-phase, star, with grounded neutral. The station switchboard consists of 11 panels, one for each generator, one for each pair of transformers and one for each exciter and five distribution panels, with space reserved for three more generators. All the high-tension switch gear is manipulated by means of remote-control apparatus, the oil-switches being located in a gallery over the fireproof transformer room. The electrical layout is extremely simple in design and the apparatus is intended to be operated with the cheapest possible local labor.

The transmission circuits are run on wooden poles heavily creosoted to prolong their life and keep out ants, the line wire being No. 8 hard drawn copper strung on Locke insulators fitted with galvanized iron pins. On starting up the plant it was found that the charging current of the transmission lines was about twice the value of the full-load current, and the wattless component of the current was lagging instead of leading, notwithstanding the induction-motor load. Aside from the stupendous problem of the transportation of material into the wilds of that mountainous country, the principal difficulty in the construction of the Cataguazes plant was to find protection from the ravaging forces of nature. These appeared in the shape of prolonged rains, lightning, white ants, small monkeys (marmosets) and large birds. Before the pole lines were completed it was found that the right-of-way through the forest had not been cut wide enough and provision had to be made to isolate the line better from animal life, and constant vigilance is still necessary on the poles themselves to discover the ant workings before the poles fall. Once in the substation, however, the difficulties are slight, and, after passing through step-down transformers, the current enters the high-tension city network at 3700 volts between phases for distribution to the 2200-volt, single-phase pole-transformers scattered throughout the streets. These pole-transformers reduce the tension to 125 volts for the multiple circuits from which both public and private lighting is taken.

FIG. 3.—DAM, HEADRACE AND PIPE LINE.

Bare, hard-drawn copper wire is used on all of the overhead work and in the high-tension work in all of the substations and in the head station itself, excepting, of course, the generator leads to the switchboards and all of the high-tension and low-tension pole lines in the cities. This system of switchboard and station wiring is extremely economical and effective.

The Cataguazes substation is a tower building of fireproof, reinforced concrete construction, having two stories. The transmission lines enter at the eves of the roof, pass through disconnecting switches and choke coils and make a circuit of the walls of the second story, serving also as busbars from

FIG. 2.—INTAKE GATES AND SPILLWAY ON SIDE OF HEADRACE.

FIG. 4.—POWER HOUSE AND PIPE LINE.

which leads are tapped off and taken directly down to the step-down transformers on the ground floor. Each of these high-tension feeders has an oil switch controlled from the switchboard and provided with an automatic over-load release. The other substations are similarly equipped.

In the construction of the head works considerable engineering skill had to be exercised to effect an economical transportation of material. The nearest point on the railroad is 25 kilometers (15 miles), the falls unfortunately being located in the heart of the "matta," or Brazilian jungle. This necessitated the construction of a new road, which cost over $20,000 (gold). Over this road the machinery and several thousand barrels of cement, and, indeed, everything else except the rock, were carried by great lumbering teams, each team consisting of 20 bullocks. These patient animals could just about make a trip one way each day, drawing one car, and were a constant source of delay and irritation. Toward the last, however, the bullocks were replaced by a steam traction engine, which made two round trips a day with three cars, a remarkable increase in efficiency.

Some idea of the importance of the transportation of material on such a job as this may be gained from the fact that upon leaving the steamer in Rio de Janeiro after a 6000-mile voyage from New York, and after being disembarked from lighters in a port which is only now constructing docks, every box and case had to be hauled inland; first, on a wide-gage railroad, then changed to a narrow-gage road and finally carted overland by ox teams on specially constructed roads and bridges, and on old bridges considerably reinforced and strengthened for the purpose.

The entire work required two years for completion, nearly one whole year of which was required to get to the falls otherwise than by horseback, and to clear the site. All of the hydraulic and mechanical work was designed and constructed by Brazilian engineers employed by Trajano de Medeiros & Company, of whom Octavio Carneiro was chief engineer. Many of these men have American shop training, and several are graduates of American technical schools. All the machinery and material, except the turbines, were brought from the United States, even to the cross-arms. The electrical equipment is Westinghouse throughout, Mr. F. J. W. Luck, the Westinghouse sales manager in Brazil, having been the consulting engineer on the work.

The Parallel Operation of Transformers.

BY J. MURRAY WEED.

THE question of parallel operation for transformers is mainly one of temperature in the various transformers. The temperature rise in any transformer depends upon the power lost in the core, or iron loss; and the power lost in the coils, or copper loss.

The iron loss is only slightly affected by parallel operation, since, for a given transformer, it depends only upon the applied e.m.f.

The copper loss depends principally upon the distribution of the load current among the transformers. A change in the distribution of the load current will produce an increase in the temperature of those transformers supplying the increased current, accompanied by a reduction in the temperature of those transformers in which the current is reduced. The copper loss depends also, in part, upon the production, between different transformers, of local currents which are 90 deg. out of time-phase with the load current. The actual current in any transformer is the resultant of the out-of-phase component and the load component. In time-phase position, it leads the load current in certain transformers, and lags behind it in others. Since, whether lagging or leading, the resultant current is greater than its load current component, an increase in temperature is produced by the out-of-phase current in all of the transformers affected.

The proper distribution of the load current, considered on the basis of temperature, should be such that the temperature rise will be the same in all of the transformers. This condition does not necessarily mean that the current supplied by each transformer is proportional to the manufacturer's rating, since this rating may be more conservative in some cases than in others. In this connection it must be remembered that, ordinarily, large transformers are not rated by the manufacturers on the basis of a certain temperature rise, but they are designed under a guarantee not to exceed a certain temperature rise when operating at a chosen load. The results will usually justify an increased rating of the transformer on the basis of the temperature specified, this increase being greater in some cases than in others.

Though, for the ideal condition of parallel operation, there will be no out-of-phase current, yet the local currents, 90 deg. out of time-phase with the load current, may have a considerable value with only a slight increase in the actual resultant currents, and in the heating of the transformers caused thereby. Thus the out-of-phase current in any transformer may reach a value equal to 20 per cent of the load current with an increase of less than 2 per cent in the resultant current, and with only

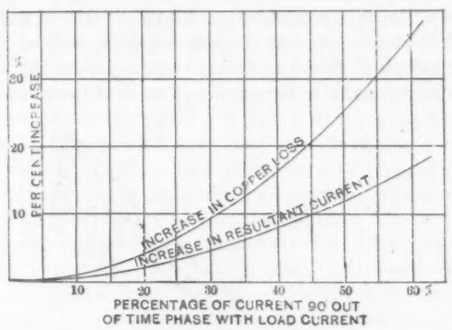


FIG. 1.—VARIATION OF COPPER LOSS AND RESULTANT CURRENT WITH CHANGE IN OUT-OF-PHASE CURRENT.

4 per cent increase in the heat generated in the windings. For satisfactory parallel operation, therefore, it is only necessary that the out-of-phase current should not exceed a limit of, say, 20 per cent or more of the load current. The percentage increase in the resultant current, and in the copper loss, resulting from any percentage of current 90 deg. out-of-phase with the load current, is shown in Fig. 1.

Assuming an equal voltage-ratio for all of the transformers, the distribution of the load current and the production of local out-of-phase currents depend upon the impedance characteristics of the transformers. Knowing these, it is easy to determine whether or not the transformers will operate satisfactorily in parallel. These characteristics may usually be ascertained from the manufacturers, in the form of "per cent impedance" and "per cent copper loss," or they may be observed from tests made on the transformers themselves.

By the per cent impedance volts is meant the per cent of normal primary e.m.f. which must be applied to the primary terminals of the transformer to force full-load current through the windings when the secondary is short-circuited. This e.m.f. is the resultant of two components 90 time-degrees apart which may be termed the per cent resistance drop and the per cent reactance drop, the former being in phase with the current and the latter being 90 deg. ahead of it. These e.m.fs., when not expressed in per cent, will be called impedance e.m.f., resistance e.m.f., and reactance e.m.f., respectively.

The impedance e.m.f. may be measured directly. The resistance e.m.f. is equal to the primary current multiplied by the equivalent resistance of the transformer, which may be obtained by measuring the resistance of both the primary and the secondary, and adding to the primary resistance the secondary resistance divided by the square of the ratio of transformation. The resistance e.m.f. is often determined more conveniently by dividing the copper loss of the transformer by the primary current. The reactance e.m.f. may be calculated from the known

values for the impedance e.m.f. and the resistance e.m.f. Thus, if IZ = the impedance e.m.f., IR = the resistance e.m.f., and IX = the reactance e.m.f., $IX = \sqrt{(IZ)^2 - (IR)^2}$

Some insight into the general problem of the parallel operation of transformers may be obtained by considering practically the simple case of two transformers. At first, suppose the transformers to be operating from the same primary circuit, but on separate secondary circuits, both transformers being fully loaded, with loads at the same power factor. The impedance e.m.fs., and their resistance and reactance components, are represented for the two transformers, respectively, by the triangles A_1BC_1 and A_2BC_2 of Fig. 2. The e.m.f. on the secondary terminals at no-load is OB. The e.m.fs. on the secondary terminals of the different transformers, when loaded, are OA_1 and OA_2. The currents in the secondary circuits are OI_1 and OI_2, lagging behind their respective e.m.fs. by the same angle θ. OA_2 is seen to lag behind OA_1, and, therefore, OI_2 behind OI_1 on account of the relative values of resistance and reactance e.m.fs. in the two transformers.

Now, suppose a switch to be closed, throwing the two transformers in parallel at the secondary terminals. Neglecting the slight changes which will take place in the numerical values of the e.m.fs. on the secondary terminals of the transformers, the total load current, and its power factor, will be the same after the switch is closed as before. At any rate, the load may be adjusted to make it the same. The total load current will

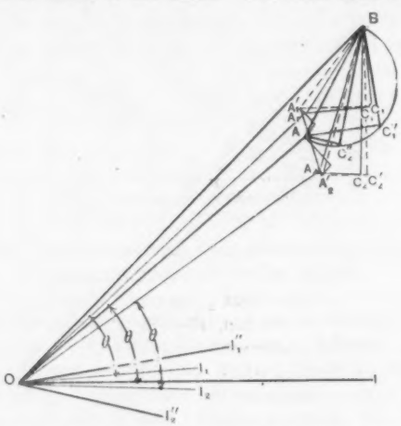


FIG. 2.—VOLTAGE AND CURRENT DIAGRAM OF TRANSFORMERS IN PARALLEL.

then be equal numerically to $OI_1 + OI_2$, and its time-phase position will be intermediate between OI_1 and OI_2.

With current in this time-phase only in both of the transformers, the triangles A_1BC_1 and A_2BC_2 would assume the positions $A_1'BC_1'$ and $A_2'BC_2'$, the resistance components being in time-phase with the current, and the reactance components being 90 time-degrees ahead of it.

There is obtained now the e.m.f. $A_1'A_2'$, which must be consumed in circulating a current through the local circuit between the two transformers. This current will depend, in magnitude and time-phase, upon the e.m.f. $A_1'A_2'$, and upon the combined impedance of the two transformers. It will be of equal value in both transformers, and may, in general, be resolved into two rectangular components, one component being in time-phase with the load current in one transformer and opposed to it in the other, thus, in reality, effecting a change in the division of the load current between the two transformers. The other component of the circulating current will be 90 time-degrees ahead of the load current in one of the transformers and will lag 90 time-degrees behind it in the other.

The e.m.fs. on the secondary terminals of the transformers have now assumed a common value, OA, intermediate in time-phase between OA_1' and OA_2'. The exact position of A depends upon the relative values of the resistances and the reactances in the two transformers, $A_1'A$ and $A_2'A$ being the impedance e.m.fs. due to the total local circulating current in the transformers in which the out-of-phase component is leading and lagging, respectively. The time-phase angle between the load current, OI, and the e.m.f., OA, is, of course, θ. The actual resultant currents in the different transformers are OI_1'' and OI_2'', the time-phase and magnitude of each corresponding to the respective e.m.f. triangle ABC_1'' and ABC_2''. The resultant of OI_1'' and OI_2'' is, of course, OI.

One is now able, from a study of Fig. 2, to arrive at some useful deductions. Thus, if several transformers, similarly rated with reference to their temperature characteristics, have impedance, resistance and reactance e.m.fs. which are, respectively, equal, the points A_1', A_2', etc., will fall together at the point A, and there will be no e.m.f. to produce local currents. The currents in all of the transformers being in the same time-phase, the load current is the arithmetical sum of these separate currents, and is divided among the transformers in proportion to their ratings. This condition seldom exists except in transformers made according to the same design, and is not exact even in that case. A fairly close approximation may be obtained in special cases in transformers of different design, and sometimes in transformers of different ratings, although the impedance characteristics of transformers of different ratings are inherently different. Where the impedance characteristics are made the same for transformers of different ratings it is usually at the expense of a greater divergence in other points.

If the impedance, resistance and reactance e.m.fs. for several transformers are not equal, but are in the same proportion relative to each other, the points A_1', A_2', etc., though not falling together, will fall upon the same straight line AB. Any e.m.f. tending to circulate currents between different transformers will be directly in time-phase with, or directly opposed to, their respective impedance e.m.fs., thereby effecting a change in the distribution of the load current, but producing no out-of-phase current. The load current will, in this case also, be equal to the arithmetical sum of the currents in the separate transformers, but it will not be divided among them in proportion to their ratings corresponding to the impedance, resistance, and reactance e.m.fs. above referred to, but in proportion to other ratings such that these e.m.fs. will be respectively equal for the different transformers. This condition may result in the over-heating of some of the transformers, while some others may run cooler than necessary.

If the impedance e.m.fs. are equal for all the transformers, but the resistance and reactance components are in different proportion, the points A_1', A_2', etc., will not fall together, but all will be at the same distance from B, falling upon the arc of a circle. The e.m.f. tending to circulate between any two transformers is approximately at right angles to the respective impedance e.m.fs., the approximation, being nearer, the smaller is the time-phase difference between these impedance e.m.fs. The local circulating current will, in this case, therefore, have only a slight effect upon the distribution of the load current among the transformers, but it will have a large component in time-quadrature to the load current. The resultant currents in the different transformers will differ in time-phase from each other, and their arithmetical sum will be greater than the load current, which is their resultant. The temperature of all the transformers affected will be increased, though, as already explained, the current 90 deg. out of time-phase may have considerable value without serious results.

It is interesting to note, in general, the apparently differing power factors in different transformers. Certain transformers supply more than their share of the wattless component of the load current, while others supply more of the watt component. This result, however, is a matter of small importance, since, with a certain power factor of the load, there is a certain amount of wattless current which must be taken care of, and if one transformer takes more than its share of this current, it relieves another of this current so that it may take a greater amount of the watt component. The only important consideration is the amount by which the arithmetical sum of the currents in the separate transformers exceeds the resultant load current. As explained above for a single transformer, and as applicable to the entire group, the total current 90 deg. out of

time-phase with the load current may be equal to 20 per cent of the total load current with an increase of less than 2 per cent in the arithmetical sum of the currents in the different transformers, and with an increase of just 4 per cent in the heat generated in the various windings. This would probably mean an increase of about 2 per cent in the temperature rise. It is thus seen that transformers will operate satisfactorily in parallel provided they have equal impedance e.m.fs., though there may be considerable difference in the relative values of the resistance and reactance components.

It may be noted here that a change in the power factor of the load has absolutely no effect upon the parallel operation of transformers when there is no difference in ratio. The currents in the different transformers bear a definite time-phase relation to the resultant load current, regardless of its time-phase relation to the applied e.m.f.

It is well now to proceed to the analytical solution of the general case of the parallel operation of transformers of the same ratio. The actual impedance e.m.f. must be the same, in phase and in magnitude, for all the transformers of the group. The current in each transformer will have such a value as to produce this impedance e.m.f., and will lag behind it by an angle Θ_n whose cosine for the particular transformer is equal to the resistance e.m.f. divided by the impedance e.m.f. and whose sine equals the reactance e.m.f. divided by the impedance e.m.f. The currents in the different transformers will, in general, differ from each other in time-phase; the resultant of all these currents will constitute the load current.

Let the currents corresponding to the ratings of the respective transformers be I_1, I_2, etc. Let the impedance, resistance and reactance e.m.fs. corresponding to these ratings be I_1Z_1, I_1R_1 and I_1X_1; I_2Z_2, I_2R_2 and I_2X_2, *etc.* Suppose that it is desired to operate the transformers in parallel carrying a resultant load current, I. Let the impedance e.m.f. for the group, with this load current, be IZ, the value of Z being unknown. Now the currents in the different transformers will be

$$I_1' = I_1 \frac{IZ}{I_1Z_1}\,;\quad I_2' = I_2 \frac{IZ}{I_2Z_2}\,,\ \text{etc.}$$

Each of these currents may be resolved into two rectangular components, one in time-phase with IZ, and the other lagging 90 time-degrees behind IZ. The components will be

$$I_1' \cos\Theta_1 = I_1 \frac{IZ}{I_1Z_1}\cos\Theta_1 = I_1 \frac{IZ}{I_1Z_1}\times\frac{I_1R_1}{I_1Z_1} = \frac{R_1IZ}{Z_1^2}$$

and

$$I_1' \sin\Theta_1 = I_1 \frac{IZ}{I_1Z_1}\sin\Theta_1 = I_1 \frac{IZ}{I_1Z_1}\times\frac{I_1X_1}{I_1Z_1} = \frac{X_1IZ}{Z_1^2},\ \text{etc.}$$

The resultant of the sums of all the components in phase with IZ, and all those 90 deg. behind IZ, will be the load current, so that

$$I = \sqrt{\left(\frac{R_1IZ}{Z_1^2}+\frac{R_2IZ}{Z_2^2}+\cdots\right)^2+\left(\frac{X_1IZ}{Z_1^2}+\frac{X_2IZ}{Z_2^2}\cdots\right)^2}$$

$$= IZ\sqrt{\left(\frac{R_1}{Z_1^2}+\frac{R_2}{Z_2^2}+\cdots\right)^2+\left(\frac{X_1}{Z_1^2}+\frac{X_2}{Z_2^2}+\cdots\right)^2}$$

whence

$$Z = \frac{1}{\sqrt{\left(\frac{R_1}{Z_1^2}+\frac{R_2}{Z_2^2}+\cdots\right)^2+\left(\frac{X_1}{Z_1^2}+\frac{X_2}{Z_2^2}+\cdots\right)^2}}$$

Now the percentages of full-load current carried by the various transformers when the resultant load current is

$$I \text{ are } \frac{I_1'}{I_1} = \frac{IZ}{I_1Z_1},\ \frac{I_2'}{I_2} = \frac{IZ}{I_2Z_2}\,,\ \text{etc.}$$

The above expression for Z is the standard formula for the joint impedance of a group of parallel circuits, R_1, X_1, and Z_1, R_2, X_2, and Z_2, etc., being the resistances, reactances, and impedances of their respective branches. The currents in the different transformers of a group in parallel, as found above, are, in fact, the same—due consideration being given to the ratio of transformation—as would be found in the separate branches of a group of parallel circuits of any other nature having the same resistances and reactances respectively as the transformers, when connected in series with the same load and subjected to the same applied e.m.f. This formula may, however, be put in more convenient form for practical application in connection with the test reports of the transformers by restoring the current values which have been cancelled, and multiplying both numerator and denominator of the second member of the equation by E, the e.m.f. of the transformers. Thus there is obtained,

$$IZ = \frac{EI}{\sqrt{\left\{EI_1\frac{I_1R_1}{(I_1Z_1)^2}+EI_2\frac{I_2R_2}{(I_2Z_2)^2}+(\text{etc.})\right\}^2+\left\{EI_1\frac{I_1X_1}{(I_1Z_1)^2}+EI_2\frac{I_2X_2}{(I_2Z_2)^2}+(\text{etc.})\right\}^2}}$$

where EI is the total load in volt-amperes, and EI_1, EI_2, etc., are the respective ratings of the transformers in volt-amperes. The values of I_1R_1, I_1X_1, and I_1Z_1, of I_2R_2, I_2X_2, and I_2Z_2, etc., may be taken directly from the test report, expressed either in volts, or in percentages, the value obtained for IZ being expressed accordingly.

It should be noted in connection with the above that the distribution of current so obtained is that which occurs when the transformers are connected together directly at the terminals. Should there be additional impedances, not a part of the transformers themselves, but included in their respective parallel branches, the resistance and reactance components of these impedances must be included with the like components of the transformer impedance in each case in determining the distribution of current. This consideration is very important in connection, for instance, with the location of transformers in a distributing network. The division of load among the transformers depends as much upon their respective location with reference to the load and to each other, and upon the sizes of conductors used, as upon the characteristics of the transformers themselves. Transformers with very different percentages of impedance may be made to operate satisfactorily together on such a system by properly selecting their respective locations and the sizes of conductors used. In the case of a group of transformers located at some distance from a common load, differences in the percentages of impedance in the different transformers may be compensated for by running separate circuits from the transformers to the load, and connecting them together at the load end only, the conductors of the separate circuits being properly selected so that the percentages of impedance of the respective transformers and circuits combined will be approximately equal. The secondary circuits of the transformers are thus made to perform the function of paralleling coils for the transformers.

In what has gone before no account has been taken of any discrepancies in the ratio of transformation. It is of frequent occurrence, however, that transformers of the same nominal ratio actually differ slightly in their ratio, and it often happens that it is desired to operate transformers in parallel which differ somewhat in ratio.

The e.m.f. A_1' A_2', Fig. 2, which tends to circulate a local current between transformers of different impedance characteristics, but having the same ratio, has a value which is proportional to the load. In transformers differing somewhat in ratio, there is, in addition to this variable e.m.f., an e.m.f. due to the difference in ratio, which is constant, and which also must be consumed in circulating current between the transformers. This e.m.f. would be represented by a difference in the length of OB, Fig. 2, for the different transformers. Thus, let OB_1 and OB_2, Fig. 3, represent the e.m.fs. on the secondary terminals, at no-load, of two transformers of different ratio when operating from the same primary circuit, but on separate secondary circuits. If they are connected in parallel at the secondary terminals, still with no-load, the e.m.f. on the secondary terminals will become OB. B_1B and B_2B are the impedance e.m.fs. set up in the respective transformers by the local current produced by the e.m.f. B_1B_2 acting upon the impedance of the two transformers in series. The exact location of B depends upon the relative values of

resistances and reactances in the two transformers. Now if the transformers are subjected to load, the conditions represented in Fig. 2 will be superimposed upon those of Fig. 3, the e.m.f. OB of Fig. 3 being taken as OB of Fig. 2. The currents in the two transformers will be the resultants of OI_1'' of Fig. 2 and OI_1 of Fig. 3 and OI_2'' of Fig. 2 and OI_2 of Fig. 3 respectively.

The currents existing in the various transformers of a parallel group, the load upon the group being known, may be

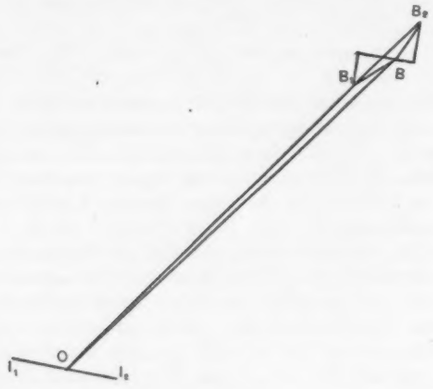


FIG. 3.—VOLTAGE DIAGRAM OF TRANSFORMERS OF DIFFERENT RATIOS IN PARALLEL.

determined, when the transformers differ in ratio and in impedance characteristics, as follows:

The no-load secondary e.m.fs. for the different transformers (primary e.m.f. multiplied by respective ratios of transformation) are E_1, E_2, etc., represented in Fig. 4 by OB_1, OB_2, etc. The common e.m.f. on the secondary terminals with the given load is E, represented by OA. The load current, I, is represented by OI, and the power factor is cos Θ. The currents in the different transformers, I_1, I_2, etc., are such as to produce the impedance e.m.fs. B_1A, B_2A, etc., and their resultant is I.

The current in each transformer may be separated into two components in time-quadrature such that the impedence e.m.f. due to one component will be opposed to the no-load secondary e.m.f., while the impedance e.m.f. due to the other com-

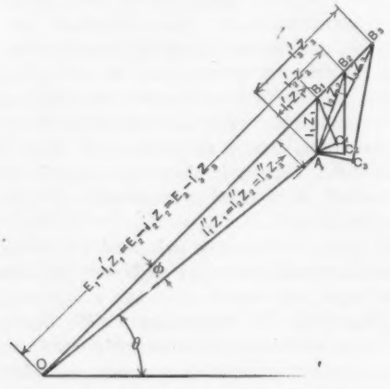


FIG. 4.—VOLTAGE DIAGRAM OF TRANSFORMERS OF DIFFERENT RATIOS AND DIFFERENT IMPEDANCE CHARACTERISTICS IN PARALLEL.

ponent will be in time-quadrature to it. These components may be designated by I_1' and I_1'', I_2' and I_2'', etc. Thus in the case of the first transformer $I_1'Z_1$ is directly opposed to E_1 while $I_1''Z_1$ is in time-quadrature to it, I_1' and I_1'' being "rectangular" components of I_1. The position of A and the value of I_1Z_1 being unknown, one cannot know the values of I_1' and I_1''. It is known, however, that the components of the impedance e.m.f. in time-quadrature with the no-load secondary e.m.fs. are the same for all of the transformers, and that the other component subtracted from the no-load e.m.f. will give e.m.fs. which are equal for all. One may then write the equations

$$E_1 - I_1'Z_1 = E_2 - I_2'Z_2 = \text{(etc.)} \qquad (1)$$

and

$$I_1''Z_1 = I_2''Z_2 = \text{(etc.)} \qquad (2)$$

In general, the similar current components, as I_1', I_2', etc., will not be in the same time-phase in the different transformers, the time-phase in each case depending upon the relative values of the resistance and the reactance in the particular transformer. Each of these components may now, however, be resolved into two "rectangular" components, one of which will be in time-phase with the no-load e.m.f. and the other in time-quadrature to it. The sums of all these respective components will then be "rectangular" components of the load current, which is known, and may be resolved into its components. Thus,

$$I\cos(\Theta+\phi) = I_1'\frac{R_1}{Z_1} + I_1''\frac{X_1}{Z_1} + I_2'\frac{R_2}{Z_2} + I_2''\frac{X_2}{Z_2} + \text{(etc.)} \qquad (3.)$$

and

$$I\sin(\Theta+\phi) = I_1'\frac{X_1}{Z_1} + I_1''\frac{R_1}{Z_1} + I_2'\frac{X_2}{Z_2} + I_2''\frac{R_2}{Z_2} + \text{(etc.)} \qquad (4.)$$

Now from equation (1)

$$I_2' = \frac{I_1'Z_1 - E_1 + E_2}{Z_2},\quad I_3' = \frac{I_1'Z_1 - E_1 + E_3}{Z_3},\ \text{(etc.)} \qquad (5.)$$

and from equation (2)

$$I_2'' = I_1''\frac{Z_1}{Z_2},\quad I_3'' = I_1''\frac{Z_1}{Z_3},\ \text{(etc.)} \qquad (6.)$$

Moreover,

$$\cos(\Theta+\phi) = \cos\Theta\cos\phi - \sin\Theta\sin\phi$$

and

$$\sin(\Theta+\phi) = \sin\Theta\cos\phi + \cos\Theta\sin\phi$$

where

$$\sin\phi = \frac{I_1''Z_1}{\sqrt{(E_1 - I_1'Z_1)^2 + (I_1''Z_1)^2}} \qquad (7.)$$

and

$$\cos\phi = \frac{E_1 - I_1'Z_1}{\sqrt{(E_1 - I_1'Z_1)^2 + (I_1''Z_1)^2}} \qquad (8.)$$

Substituting these various values in equations (3.) and (4.) there are obtained two equations with only two unknown quantities, namely I_1' and I_1''. These equations are difficult to manage, however, and approximate equations may be obtained which are much simpler by assuming values for sin ϕ and cos ϕ. It is known that cos ϕ is almost equal to unity, and it may be taken as unity. The value of sin ϕ will be zero at some power factor, and this value may be assumed for an approximate solution with no great error in the result.

Making the substitutions, one may rewrite equations (3.) and (4.) thus

$$I(\cos\Theta - \sin\phi\sin\Theta) = I_1'\frac{R_1}{Z_1} + \frac{(I_1'Z_1 - E_1 + E_2)R_2}{Z_2^2} + \text{(etc.)}$$
$$+ I_1''\frac{X_1}{Z_1} + I_1''\frac{Z_1X_2}{Z_2^2} + \text{(etc.)} = I_1'\left(\frac{R_1}{Z_1} + \frac{Z_1R_2}{Z_2^2} + \text{(etc.)}\right)$$
$$+ I_1''\left(\frac{X_1}{Z_1} + \frac{Z_1X_2}{Z_2^2} + \text{(etc.)}\right) + (E_2 - E_1)\frac{R_2}{Z_2^2} + \text{(etc.)} \qquad (3a.)$$

and

$$I(\sin\Theta + \sin\phi\cos\Theta) = I_1'\frac{X_1}{Z_1} + \frac{(I_1'Z_1 - E_1 + E_2)X_2}{Z_2^2} + \text{(etc.)}$$
$$+ I_1''\frac{R_1}{Z_1} + I_1''\frac{Z_1R_2}{Z_2^2} + \text{(etc.)} = I_1'\left(\frac{X_1}{Z_1} + \frac{Z_1X_2}{Z_2^2} + \text{(etc.)}\right)$$
$$+ I_1''\left(\frac{R_1}{Z_1} + \frac{Z_1R_2}{Z_2^2} + \text{(etc.)}\right) + (E_2 - E_1)\frac{X_2}{Z_2^2} + \text{(etc.)} \qquad (4a.)$$

Using any roughly approximate value for sin ϕ, the solution of equations (3a.) and (4a.) will give values for I_1' and I_1'', which are almost correct. If more accurate results are desired, these values for I_1' and I_1'', may be substituted in equation (7.) to obtain a closer approximation for the value of sin ϕ, and the

new value for sin ϕ may be used in equations (3*a*.) and (4*a*.). The new values for I_1' and I_1'' so obtained will be sufficiently exact.

By the use of equations (5.) and (6.) the values of I_2' and I_2'', and of I_3' and I_3'', etc., may now be obtained. Having these, the currents in the various transformers are known, since

$$I_1 = \sqrt{(I_1')^2 + (I_1'')^2},\ I_2 = \sqrt{(I_2')^2 + (I_2'')^2},\ \text{etc.}$$

To find the currents in the various transformers at no-load due to differences in the transformation ratio, it is only necessary to put I equal to zero in equation (3*a*.) and (4*a*).

It may be interesting to note that equations (3*a*.) and (4*a*.) are perfectly general, whether differences in the transformation ratio exist or not. If the ratios of the various transformers are equal, the terms containing $(E_2 - E_1)$, $(E_3 - E_1)$, etc., disappear. If the ratios are equal and the load current is zero, the equations show that the currents in the transformers are zero.

Parallel Operation of Stationary Transformers.

BY H. BEWLAY.

It is well known that transformers of different sizes or makes when operated in parallel will not always divide the load in proportion to their ratings. A common method of calculating the portion of the load taken by each transformer is based on the assumption that the total load is the arithmetical sum of the current outputs of the several transformers. This method is correct only when the ratio of the resistance to the reactance drop is the same for each of the transformers in the group.

An examination of the various lines of small lighting transformers on the American market shows that the reactance drops are smallest in the small sizes and may be twice as large in a 50-kw as in a 1-kw transformer of the same make, while the resistance drops are smallest in the larger sizes and may be three times as great in a 1-kw as in a 50-kw transformer of the same make. It hence follows that transformers of different sizes, even if of the same make, will not generally have the same ratio of resistance to reactance drop.

In view of the above facts, a correct method of calculating the loading of each transformer in a bank and an investigation of the probable errors of the approximate method may be of interest.

The data necessary for this purpose may be obtained from the regulation at two different power factors (information usually given by the makers) or from the usual tests.

As an example, consider two transformers in parallel, designated as No. 1 and No. 2, respectively. Let

W_1 and W_2 denote the total copper losses in watts at working temperature.

E_1 and E_2 denote the short-circuit impedance voltages at the same temperature.

I_1 and I_2 denote the *rated* currents in amperes.

The effective resistance is

$$R_1 = \frac{W_1}{I_1}$$

The impedance $Z_1 = \dfrac{E_1}{I_1}$

The reactance $X_1 = \sqrt{Z_1^2 - R_1^2}$

And the admittance $Y_1 = \dfrac{1}{Z_1} = \sqrt{\left(\dfrac{R_1}{Z_1^2}\right)^2 + \left(\dfrac{X_1}{Z_1^2}\right)^2}$

In a similar manner R_2, Z_2, X_2 and Y_2 may be calculated.

The total short-circuit admittance of the two transformers in parallel is the vector sum of Y_1 and Y_2, which may be denoted by Y_T. Hence,

$$Y_T = \sqrt{\left(\frac{R_1}{Z_1^2} + \frac{R_2}{Z_2^2}\right)^2 + \left(\frac{X_1}{Z_1^2} + \frac{X_2}{Z_2^2}\right)^2}.$$

And the short-circuit impedance voltage for the two transformers in parallel, which may be denoted as E_T, is

$$E_T = \frac{I_T}{Y_T} \text{ where } I_T = I_1 + I_2.$$

The current outputs of the two transformers, which may be denoted as I'_1 and I'_2, will be:

$$I'_1 = E_T Y_1 = E_T \sqrt{\left(\frac{R_1}{Z_1^2}\right)^2 + \left(\frac{X_1}{Z_1^2}\right)^2},$$

$$I'_2 = E_T Y_2 = E_T \sqrt{\left(\frac{R_2}{Z_2^2}\right)^2 + \left(\frac{X_2}{Z_2^2}\right)^2}.$$

It is evident from these expressions that the currents are in time-phase only when

$$\frac{R_1}{X_1} = \frac{R_2}{X_2}.$$

The common method is as follows:

$$\frac{E_1}{I_1} = Z_1$$

$$Y_1 = \frac{1}{Z_1} \text{ and similarly } Y_2 = \frac{1}{Z_2}.$$

Adding arithmetically

$$Y_1 + Y_2 = \frac{1}{Z_1} + \frac{1}{Z_2}$$

$$= \sqrt{\left(\frac{R_1}{Z_1^2}\right)^2 + \left(\frac{X_1}{Z_1^2}\right)^2} + \sqrt{\left(\frac{R_2}{Z_2^2}\right)^2 + \left(\frac{X_2}{Z_2^2}\right)^2}$$

$= Y'_T$, where Y'_T denotes the total short-circuit admittance calculated by the common method. Similarly,

$$\frac{I_T}{Y'_T} = E'_T,$$

where E'_T is the short-circuit impedance voltage for the group by the common method.

Similarly denoting the current outputs of the two transformers by I_1'' and I_2''

$$I_1'' = E'_T Y_1$$

and

$$I_2'' = E'_T Y_2$$

Hence,

$$\frac{I_1'}{I_1''} = \frac{I_2'}{I_2''} = \frac{E_T}{E'_T} = \frac{Y'_T}{Y_T}.$$

$$= \frac{\sqrt{\left(\frac{R_1}{Z_1^2}\right)^2 + \left(\frac{X_1}{Z_1^2}\right)^2} + \sqrt{\left(\frac{R_2}{Z_2^2}\right)^2 + \left(\frac{X_2}{Z_2^2}\right)^2}}{\sqrt{\left(\frac{R_1}{Z_1^2} + \frac{R_2}{Z_2^2}\right)^2 + \left(\frac{X_1}{Z_1^2} + \frac{X_2}{Z_2^2}\right)^2}}$$

It is thus seen that the actual current delivered by each transformer is greater than that calculated by the common method in the ratio

$$\frac{\text{arithmetical sum of admittances}}{\text{vectorial sum of admittances}}$$

The values of this ratio will depend on the difference in time-phase between I'_1 and I'_2, and also on the relative values of Y_1 and Y_2.

As a practical example the calculations for several cases are given below.

The following table gives the necessary data which have been calculated from the regulation figures given by the manufacturers:

Rating.		Conductance in mhos. $\frac{R}{Z^2}$.	Susceptance in mhos. $\frac{X}{Z^2}$.	Admittance in mhos. $\frac{\sqrt{R^2+X^2}}{Z^2}$	Ratio. $\frac{R.}{X.}$
Kw.	Amp.				
.5	5	1.22	.69	1.402	1.77
2	20	3.9	3.73	5.397	1.046
5	50	10.8	12.3	16.37	.878
10	100	23.3	29.3	37.44	.795
25	250	28.4	66.8	72.6	.425
50	500	38.0	116.0	122.01	.327
.5	5	1.64	.68	1.775	2.41
2	20	5.82	4.28	7.224	1.36
5	50	12.4	13.7	18.48	.905
10	100	36.1	35.0	50.28	1.03
50	500	86.0	191.0	209.5	.45

These data apply to two different lines manufactured by different companies.

Considering two 50-kw transformers in parallel (one of each type):

$$Y'_T = 122.01 + 209.5 = 331.51$$

and

$$Y_T = \sqrt{(38. + 86)^2 + (116 + 191)^2} = 331.1$$

hence

$$\frac{Y'_T}{Y_T} = \frac{331.51}{331.1} = 1.00124$$

$$I'_1 = \frac{122.01}{331.1} \times 1000 = 369 \text{ amp}$$

$$I'_2 = \frac{209.5}{331.1} \times 1000 = 633 \text{ amp.}$$

Considering the two 5-kw transformers in parallel

$$Y'_T = 16.37 + 18.48 = 34.85$$

$$Y_T = \sqrt{23.2^2 + 26^2} = 34.85$$

and

$$I'_1 = \frac{16.37}{34.85} \times 100 = 47 \text{ amp}$$

$$I'_2 = \frac{18.48}{34.85} \times 100 = 53 \text{ amp.}$$

Considering the 50 kw and the 10 kw of the first group in parallel,

$$Y'_T = 122.01 + 37.44 = 159.45$$

$$Y_T = \sqrt{51.3^2 + 145.3^2} = 157.7$$

and

$$\frac{Y'_T}{Y_T} = \frac{159.45}{157.7} = 1.0111$$

$$I'_1 = \frac{37.44}{157.7} \times 600 = 142.4 \text{ amp}$$

$$I'_2 = \frac{122.01}{157.7} \times 600 = 464.0 \text{ amp.}$$

It is thus seen that two transformers of the same size and different makes and two transformers of different sizes and the same make may or may not operate in parallel without dangerously overloading one of the transformers.

Where such parallel operation is necessary a "choke" coil should be placed in either the primary or the secondary circuit of the transformer taking the larger current, the impedance being such that the admittance of the transformer and choke coil combined has the same ratio to the admittance of the other transformer as have the rated currents of the transformers.

Under this condition the currents in the two transformers will be proportional to their ratings, although each current will, of course, be greater than the full-load current in the ratio of $\frac{Y'_T}{Y_T}$, where Y'_T is the arithmetical sum of the new admittances (allowing for the choke coil) and Y_T is the vectorial sum of the new admittances.

From a consideration of the above figures and of the general conditions limiting the resistance and reactance drops in transformers, it may be said that the error due to neglecting the differences in time-phase of the currents supplied by the several transformers in parallel will not exceed 2 per cent in most cases, and it is very doubtful if in any combination of commercial transformers the error is as great as 5 per cent.

In conclusion, it may be said that while this error is not so large as to cause any serious and unexpected heating of the transformers, so little additional labor is required to calculate the exact values of the currents that there is very little excuse for the use of an approximate method.

One exception to this statement must, however, be made, as when two transformers are needed and no data on them are available, the data necessary for the approximate method can be obtained with only a voltmeter and an ammeter, while the aid of a wattmeter, which may not be available, is necessary to separate Z into its components, R and X, which are necessary for making the exact calculation.

Experimental Determination of the Hysteretic Exponent.

By Nicholas Stahl.

When magnetizable material is subjected to cyclic variations of m.m.f., a loss of energy occurs both on account of *hysteresis*, or the time lag of the magnetization behind the producing force, and through the formation of *eddy currents*, which always accompany any variation in the number of interleakages of magnetic lines of force and a closed conducting circuit. These losses are quite separate and distinct from any Joulean and frictional losses, arising from the manner of varying the magnetizing force.

The hysteresis loss in watts per cubic inch of iron is proportional to the frequency and a certain power of the magnetic induction, or symbolically,

$$W_h = \alpha f B^x,$$

where α is a constant, f the frequency, B the maximum value of the induction, and x the exponent to which it is involved.

For the eddy-current losses, we have a similar expression,

$$W_e = \beta f^2 B^2,$$

in which x does not appear, and β is another constant.

The total iron loss is thus

$$W_i = W_h + W_e = \alpha f B^x + \beta f^2 B^2 \qquad (A)$$

As early as 1889, Dr. C. P. Steinmetz showed that for the range of magnetization ordinarily found in dynamo-electric machinery, the average value of x is 1.6; though, with change in the quality of the iron, it may vary from 1.5 to 1.9. For refinements of design, it is often important to know the value of x with considerable accuracy.

If an electric current is passed through a coil of wire placed around a closed portion of the iron under test, and the constant of the electric circuit determined by suitable instruments, the value of x may be found in various ways. It is necessary, in general, to know the frequency of the circuit, the voltage at the terminals of the coil and the watts lost in it, and the current flowing through it.

By the use of three different frequencies and a constant voltage, an exponential equation may be derived which permits the evaluation of x; but only, in general, by use of a "cut-and-try" method, or resort to particular curves not always easily accessible. This method, while possessing the advantage of only three measurements, requires two known changes in the frequency and slight errors here are magnified in the final result.

By the use of one change only in both voltage and frequency, and the four attendant readings of the wattmeter, a comparatively simple expression for x is found, which can be quickly evaluated by anyone who can use a table of logarithms.

It can easily be shown that the induction $\mathfrak{B}$ is directly proportional to the voltage v at the terminals of the magnetizing coil and inversely proportional to the frequency, or $\mathfrak{B} = K f^{-1} V$, if we neglect the resistance of the coil in comparison with its reactance, which is quite permissible by a suitable choice and arrangement of magnetizing coil, and well represents the conditions of *magnetizing current* in commercial apparatus, stationary and movable.

Inserting this value in equation (A) and putting $\alpha K^x = \gamma$ and $\beta K^2 = \delta$, we have for a given frequency and voltage =

$$W_1 = \gamma f_1^{1-x} V_1^x + \delta V_1^2 \qquad (1)$$

If, by any suitable means, we change the voltage of the circuit, the equation becomes

$$W_2 = \gamma f_1^{1-x} V_2^x + \delta V_2^2 \qquad (2)$$

A change of frequency to any other value, f_2, and the restoration of the original voltage gives,

$$W_3 = \gamma f_2^{1-x} V_1^x + \delta V_1^2 \qquad (3)$$

and finally, a change to the second voltage,

$$W_4 = \gamma f_2^{1-x} V_2^x + \delta V_2^2 \qquad (4)$$

Then

$$W_1 - W_3 = \gamma V_1^x (f_1^{1-x} - f_2^{1-x})$$

and

$$W_2 - W_4 = \gamma V_2^x (f_1^{1-x} - f_2^{1-x})$$

and, at once

$$\frac{W_1 - W_3}{W_2 - W_4} = \left(\frac{V_1}{V_2}\right)^x,$$

or

$$x = \frac{\log_{10}\left(\frac{W_1 - W_3}{W_2 - W_4}\right)}{\log_{10}\left(\frac{V_1}{V_2}\right)}$$

It is to be noted that the actual values of the frequency are of no importance; it is only required that it shall be the *same* in cases (1) and (3), likewise (2) and (4).

A suitable choice of wattmeter and voltmeter for the quantities to be measured will allow accuracy to within a small fraction of 1 per cent. The resulting computation is very simple and easily effected.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Special Central-Station Advertising at Springfield, Mass.

A special form of advertising has lately been put in effect by the United Electric Light Company, of Springfield, Mass., in connection with the introduction of new business and the retention of good-will among prominent customers. The company has made arrangements with a large accident insurance company of Chicago to furnish it with a number of policies at a nominal wholesale rate for distribution among its patrons and friends. The policies are each enclosed in a neat leather case with a transparent inside cover, so that the identity of the holder can at once be determined in case of trouble, part of the case being provided with a pocket for visiting and business cards. Each of these policies is given away absolutely without cost to the recipient, who is merely required to send his name and address with an enclosed slip to the office of the accident insurance company. General Manager W. L. Mulligan states that the results of this advertising are directly traceable, and are more profitable than the usual forms of newspaper publicity. The company's name is placed on the inside of the case in gilded letters.

In soliciting power business or important lighting contracts, the company encourages its solicitors to leave with the prospective customer a high-quality pack of playing cards in a neat leather case of the pocket-book type, and it is stated that much friendly feeling has been accorded the solicitors by the practice. In each new domestic installation the company leaves a special cake of fine toilet soap, the company's name being printed on the front side, with announcements of the service available. As the inscription is protected by a paraffin cover, it is impossible for the housewife to wash off the name of the company, and it serves as a constant reminder as long as the soap lasts. The company feels that the results of a given expenditure for such advertising are more readily apparent than in almost any other direction.

Electricity and Public Safety.

At the convention of the Western Association of Electrical Inspectors, Mr. W. J. Canada, of Denver, chairman of the committee on public safety, presented a report taking up questions of public safety in connection with electric fires which do not ordinarily come under the notice of electrical inspectors. He stated that the effort to bring about conditions of electric wiring which will result in the fewest fires and property losses is the principal cause of the establishment of electrical inspection; but all electrical inspectors face the proposition, sooner or later, that there is a life hazard also connected with electric wiring. After this question has once come up, inspectors are forced to recognize it in supervising the general wiring construction inside buildings or out.

Most organizations of electrical men have endeavored to ignore matters in which electrical construction affects the safety of the public, or at least have tried, it is alleged, to suppress references to this feature in any public matter. This obstruction of discussion and research has restricted the general knowledge of this life hazard, together with means which might be taken for its prevention. To be sure, in numerous cases lighting companies have taken the commendable stand that their ultimate interest depends upon the avoidance of dangers of these kinds by proper construction rather than by the suppression of information regarding accidents which occur from poor construction. As a matter of fact, the company which does not attempt to restrict, but rather aids the publication of information regarding those causes in electric wiring which may prove dangerous to either property or life, stands on much better footing when accidents do happen.

The Western Association of Electrical Inspectors has before it a number of methods by which it can bring about a great reduction in this hazard to life. In the first place, data must be collected. Statistics are now extremely scattered and poorly kept in this country regarding deaths and accidents by electricity. Members should interest themselves in ascertaining not only the bare facts of injury or death, but the conditions regarding the attendant circumstances. Then repetition of these accidents can be avoided by correcting the defects which cause them. As opposed to the lack of data, the very complete reports of all such injuries, together with the results of medical examinations made yearly in Germany, England and other countries, show that the matter is better considered usually in those countries, although we are in the habit of thinking that life is held at a lower value than here.

In considering wiring construction as affecting public safety, safety is first affected by fires caused by arcs; secondly, by panics resulting from arcs or fires; and thirdly, by the effect of current passing through the body. The hazard to life during fire is well known, and is being combated in every way. The same applies to panics. The causes and effects of shock, however, have not been so generally commented upon or guarded against.

So far as statistics now at hand can be relied upon, accidents to linemen and station men in charge of switchboards comprise about one-half the total number of deaths by electricity. The proportion of these deaths and injuries which could have been avoided by reasonable care on the part of the injured persons is very large—probably at least 75 per cent. The details of accidents which Mr. Canada had been able to obtain in this country are meager. Except those in the Rocky Mountain district for the last year or two, which he has personally investigated, he could not say in most cases what the circumstances were. From German, Swiss and English accounts and those obtainable in this country, it is evident that the carelessness of fellow workmen is a comparatively infrequent cause of injury. The defects of construction, as this construction is related to the safeguarding of linemen, are probably responsible directly for about 25 per cent of the injuries in this class. These defects relate to spacing of wires and carrying of different wires on the same pole. Apparently about 20 per cent of accidents to linemen are the result of partial dependence on wooden poles for insulation. The dampness of the pole has either permitted the fatal current to pass through the body or has sufficiently shocked the man to throw him to the ground.

The general result of investigation leads Mr. Canada to suggest that more careful instruction of linemen and more careful choosing of these employees would, even with existing

forms of construction, reduce the injury list at least 50 per cent. A chain "ground" from arm to foot of linemen might also reduce fatalities, and this the writer has seen used with apparent success in practice. As to changes in construction, the only suggestion is that better separation and isolation of wires at higher voltages should be sought.

Along this line it is interesting to note that about 25 per cent of all accidents to linemen and station men of a serious nature are at voltages under 300. These are voltages ordinarily, but mistakenly, considered without danger. In this statement no accidents are included which could possibly be the result of transformer leaks or the like. In Germany, Great Britain and Switzerland it is compulsory under the national statutes to ground all transformer cases in stations as well as transformer and arc light cases on poles. This is undoubtedly a great safeguard.

The number of accidents to motormen and the like, who work continuously near wires and apparatus, is larger than would at first be supposed. The data at hand would lead Mr. Canada to believe that the number is close to 25 per cent of the total number of electrical accidents. About two-thirds of the number of such accidents included in his records are due to voltages of 300 and upward. The other third is due to 500 volts. Defects in apparatus may develop through the disconnection of ground wires or from the partial insulation of a car by ice on the tracks. Any action which will tend to the more perfect grounding of train platforms and all exposed surfaces adjacent, and especially the development of a more reliable form of lightning arrester, will result in a great reduction of such accidents.

The greatest interest pertains to protection of persons in no way connected with electrical work. Injuries to this class average nearly 30 per cent of all electrical injuries. Of the injuries to the general public about 20 per cent are due to fallen wires, injuries in street cars and lightning entering buildings. Injuries due to defective insulation not in accordance with the Code are very numerous. About 20 per cent of the electrical injuries to the general public fall in this group. The injuries due to conditions whose avoidance is not contemplated in existing rules comprise by far the greater proportion of those to the general public. Among these conditions, the prominent ones, both in this country and others, are as follows, in their order of importance:

First, brass shell key sockets and flexible cords accessible to persons from baths, stoves, sinks, damp floors and the like.

Second, the ungrounded secondary having accidental contact with immediate primaries of 1100 to 2300 volts or thereabout.

Third, the general hazard caused by changes in buildings, wired knob and tube, by which wires are accidentally brought into contact with pipes.

Fourth, the use of exposed or molded wiring in basements, especially in damp ones, or about rooms having grounded surfaces.

Fifth, the absence of sufficient public instruction to prevent unauthorized persons and children from tampering with fittings.

It has been common even among informed persons to consider the higher voltages—say 1000 and above—as almost necessarily fatal where a good contact is made through the body, whereas what are commonly known as low voltages, from 300 down, have been neglected as possibly dangerous to persons, except with the most extraordinary exceptions. The percentage of fatalities among persons not engaged in electrical work at low voltages is considerably greater than the percentage for high voltages, as the general public is within reach of low-voltage wires.

Mr. Canada advocated the securing of such requirements in code rules as would remove the probability of any person forming a portion of an electric circuit, no matter how low a potential it is. Several methods suggest themselves for the accomplishment of this general scheme of protection. Where all surfaces with which the public come in contact are composed of independent insulating material or are of metallic conducting material kept strictly at the same potential by bonding and grounding, the condition of safety is ideal. To secure the complete attainment of such a condition would mean the abolition of all exposed contacts and all frail electric fittings, which would probably be impracticable at the present time. With the elimination of the flexible cord and brass shell key socket, with their attendant abuse and the certain ignorance of the public concerning danger from this source, 50 per cent of the electrical injuries to the public would be immediately done away with. In England this matter has recently been agitated to the extent that there is now up for legislation a requirement that all exposed metal parts in all classes of fixtures, including portable lamps, be thoroughly grounded and bonded together. This is frequently a difficult problem from the American way of looking at the matter.

Throughout the country we are making considerable progress in reducing the accidents of the second class; namely, those caused by the failure to ground secondary circuits and the breaking over of high-potential onto those circuits. The use of exposed or molding wiring in basements, kitchens, baths, toilets and the like should be abolished, as well as the use of molding in show-windows. Mr. Canada's committee advocated that a definite campaign should be instituted of as tactful a nature as possible to instruct the general public through the daily papers, public meetings and by other methods which might suggest themselves, with the purpose of enlisting public sentiment and securing legislation to enforce reasonable safeguards of life.

Central Station Notes from Beatrice, Neb.

The Beatrice (Neb.) Electric Company has recently been investigating and analyzing its conditions, and the results will be of interest to other small central-station companies. Beatrice is a town of about 10,000 to 12,000 population. The Beatrice Electric Company supplies power to the Electric Service Company, of Wymore, a neighboring town of some 4000 population. These two companies are under the same control, Mr. E. J. Sullivan, of Omaha, of the Nebraska Electric Company, being the chief moving spirit.

EFFICIENCY OF TRANSMISSION LINE.

The single-phase transmission line which supplies Wymore and the neighboring town of Blue Springs, is 14 miles in length and is operated at about 10,500 volts at the power station. The generator busbar voltage at Beatrice is 1150. The distribution voltage at Wymore is 2300. The step-up and step-down transformers are of 40 kw each.

The load at Wymore is almost entirely lighting. During the summer of 1908 careful tests were conducted by Mr. Frank McMaster, who has been studying and analyzing the central-station operating conditions at Beatrice and Wymore. For 14 days, from Aug. 15 to Aug. 28, 1908, watt-hour meters were placed on the 1100-volt side of the step-up transformer at Beatrice and on the 2300-volt side of the step-down transformer at Wymore, the meters being read every 24 hours. The output, as measured by the watt-hour meter at Beatrice, showed an average of 284 kw-hours per day, the maximum output for any one day being 350 and the minimum 230. Service is maintained 24 hours a day.

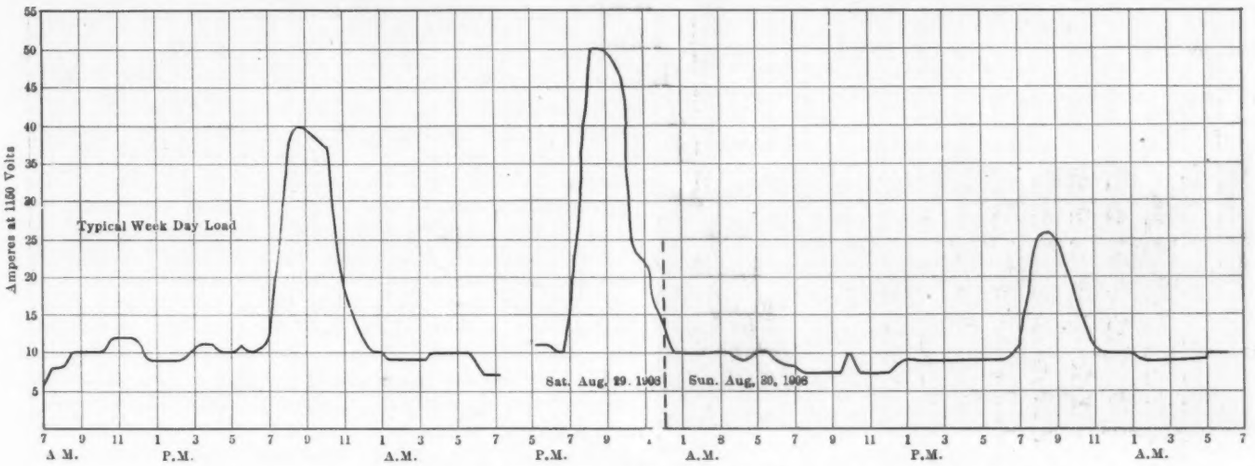
The average loss, as shown by the difference in readings of the two watt-hour meters, was 15.88 per cent, ranging from 13 to 20 per cent. This represents, of course, the all-day losses in the step-up transformer, transmission line, step-down transformer and voltage regulator, and corresponds quite closely to the calculated losses in transformers and lines. This, of course, is the loss or cost in energy of transmitting from Beatrice to Wymore.

EFFICIENCY OF A SMALL TOWN DISTRIBUTION.

All consumers at Wymore have meters, and it was found under conditions prevailing in the summer, that of all of the energy delivered to the 2300-volt distributing lines at Wymore, 58 per cent is accounted for by the Wymore customers' meters. The meters are all new and of the induction type. This is not

far from the figures obtained in other small towns where conditions are similar. The total loss between the Beatrice busbars and the Wymore consumers' is 58 per cent. That is, of the energy generated at Beatrice 42 per cent is actually sold in Wymore. The number of customers at Wymore was 221. No electric street lighting was being done at the time. The step-up and step-down transformers were fully loaded during peak load.

The monthly meter readings and collections are looked after by a man engaged also in other work, who gets $25 per month and free electric energy for his own use. Line troubles are taken care of by an electrical contractor in the town, who is paid 35 cents an hour for work of this kind. The rate for electrical energy at Wymore is 16 cents per kw-hour. Discounts for payment before the tenth of the month are 10 per



FIGS. 1 AND 2.—DAILY LOAD CURVES.

The character of the load in amperes is shown by Figs. 1 and 2, which are daily load curves showing the amperes at 1100 volts supplied to the step-up transformers at Beatrice. From this it is seen that the fixed losses and all-day lighting run from 7 amp to 10 amp. For about 2½ hours every evening the transformers are fully loaded.

The conditions, as shown by these tests, may be surprising to some who have not analyzed such matters, and who do not realize how large all-day losses may be on an alternating-current system of any kind when the load is very light during most of the day. The remedy for these conditions, which is evident to the experienced central-station man, and is being applied in this case, is securing more day load in the shape of power and heating business. This is the only thing which can improve such conditions.

The Beatrice-Wymore transmission line is shown on the

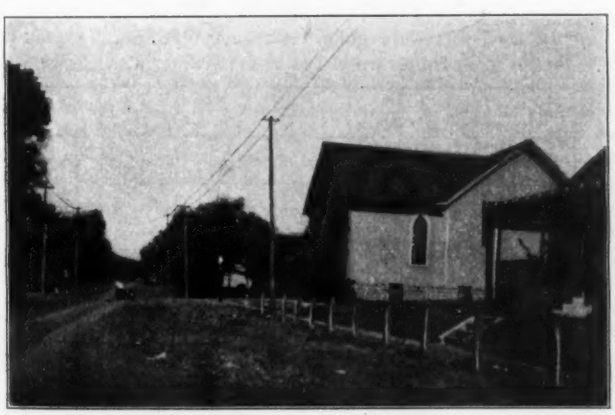


FIG. 3.—BEATRICE-WYMORE TRANSMISSION LINE.

right in Fig. 3, which is a view of one of the streets of Beatrice. This same type of construction, using 25-ft. to 30-ft. poles, is employed the entire distance except where crossing other lines. The wire is No. 6 hard-drawn copper on Hemingray insulators. The line is built on the highway the entire distance. In Beatrice, where local distributing lines are on the same pole, the construction is as shown in Fig. 4. In this the 10,000-volt lines are on the top cross-arms, the 1100-volt lines on the next cross-arm and secondary circuits on the lower cross-arm.

cent for consumption between 10 and 20 kw-hours, and 15 per cent for consumption between 20 and 30 kw-hours.

BEATRICE POWER STATION.

The plant of the Beatrice Electric Company, shown in Figs. 5 and 8, contains three-phase, 60-cycle, 1100-volt generating apparatus, with a total capacity of 225 kw. There is one 150-kw generator, driven by an 18-in. x 36-in. Murray-Corliss engine, and one 75-kw generator, driven by a Sioux City Corliss engine. Both engines are run condensing. The boiler plant consists of one Heine boiler, rated at 300 hp, and two 16-ft. x 6-ft. boilers of the horizontal return flue type. The condenser is of the Baragwanath barometric type, with a 9-in. pipe. The plant is operated with from 25 in. to 26 in. of vacuum and is near a river; the suction lift for the condenser pump is about 12 ft. There is a very substantial steel chimney, 5 ft. internal diameter and 100 ft. high. A system of steam-jet blowers for removing the soot from the tubes of the water-tube

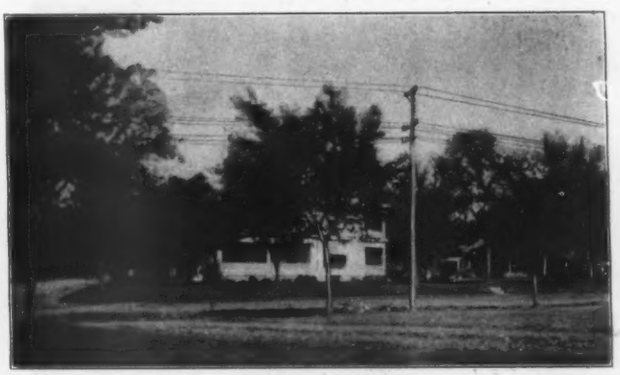


FIG. 4.—TRANSMISSION AND DISTRIBUTION LINES.

boilers has just been put in. Coal costs $2.65 per ton, the per cent of ash being about 20. The coal consumption per kw-hour is about 9.32 lb., costing 1.238 cents. The fixed power house expense, which includes labor, insurance and other fixed expenses, is 0.76 cent. Oil costs 0.0524 cent; waste, 0.03 cent, and packing, 0.00346 cent.

The men work in 12-hour shifts, two men on a shift. The chief engineer of the plant spends part of his time at the station and part as motor solicitor, as he is in an excellent position to be able to handle matters pertaining to isolated steam

plants through long experience in steam-plant work. The output from this power station Oct. 1 was 1700 kw-hours, of which 350 were delivered to the Wymore transmission line. The output Saturday, Sept. 26, was 2100 kw, or which 340 were de-

FIG. 5.—STATION AT BEATRICE.

livered to the Wymore line. Fig. 6 shows the step-up transformer, 10,000-volt arresters and feeder regulator for the Wymore transmission.

INCREASE OF POWER LOAD AT BEATRICE.

The two ampere curves for Aug. 22 to 23, 1908, and Dec. 23, 1905, Figs. 7 and 9, show what a notable increase in power load during the day there has been in three years. Most of this increase has been very recent, 58 motors of a total horse-power of 130 having been put in within 18 months. The horse-power of motors connected up to Oct. 1, 1908, was 155.

The power transformers, which are separate from lighting transformers, aggregate 102.2 kw, being 27 in number. The

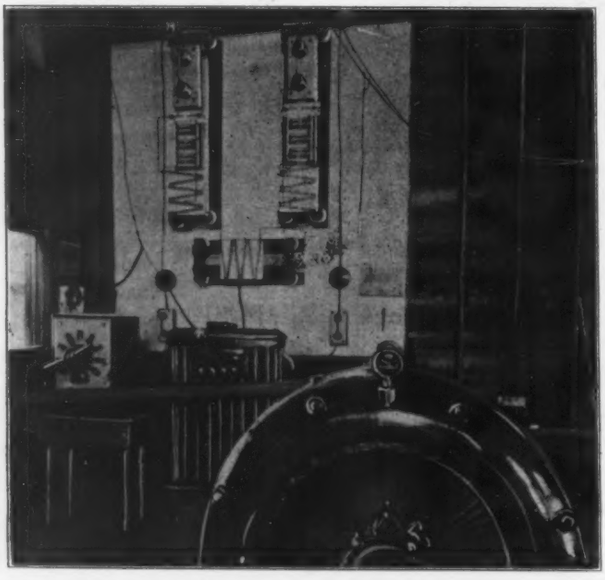


FIG. 6.—STEP-UP TRANSFORMER AND REGULATOR AT BEATRICE.

largest power transformer installation is 30 kw, consisting of three 10-kw transformers. The smallest power transformer is 1.2 kw.

LIGHTING LOAD CONNECTED.

The company has 838 customers, including light and motor customers. About 40 of these are on flat rate, being too small to justify a meter. There are 58 lighting transformers, having a capacity of 270 kw. The ratio of lighting transformer capacity to sockets wired, figuring 50 watts per socket, is 48.5 per cent. The sockets per consumer are 13.4. Consumers per transformer average 9.8. The sockets connected aggregate 11,278.

ILLUMINATING ENGINEERING.

A special effort is being made to get in a number of good, efficient lighting installations with tungsten lamps in places

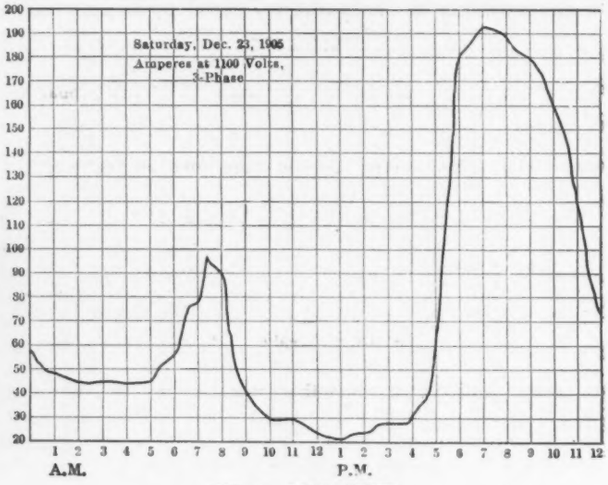


FIG. 7.—LOAD CURVE.

where they will be a good advertisement for the service. One of these, in the auditorium of the Presbyterian Church, consists of 10 250-watt tungsten lamps in a room 54 ft. x 70 ft.

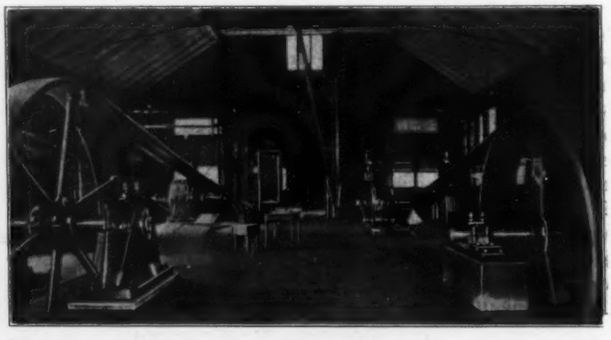


FIG. 8.—INTERIOR OF BEATRICE STATION.

These are used with the regular Holophane reflectors made for these lamps. The lamps are placed at the ceiling, which is very

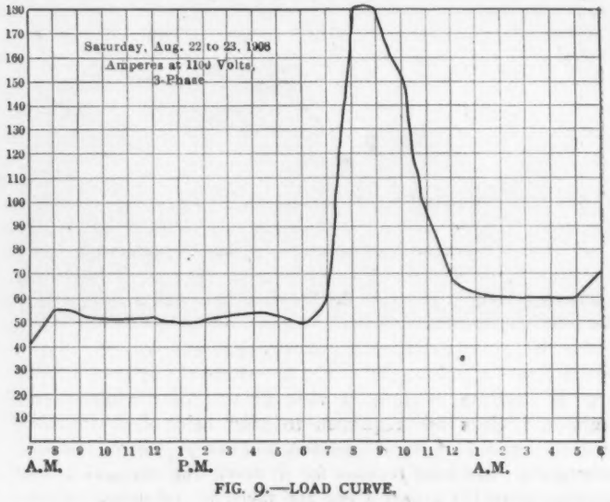


FIG. 9.—LOAD CURVE.

high. The walls are of very light color, and part of the roof is slanting, the conditions being excellent for efficient lighting. The watts per square foot in this installation are 0.66. With only half of the lamps burning, the illumination is better than in the majority of churches.

INTERIOR WIRING AND ILLUMINATION

Imparting a Time Element to Circuit-Breakers.

It is often desirable in the operation of electric apparatus equipped with a circuit-breaker to equip the latter with some device to prevent it from opening at every momentary and abnormal rush of current. At the same time the device should not militate against the operation of the circuit-breaker at the critical moment. There have been a number of relays brought forth from time to time for the purpose of imparting a time lag to circuit-breakers, and with most of them there is more or less uncertainty regarding their operation at the proper moment.

The solenoid dashpot form of time lag, when applied directly to the trip coil of the circuit-breaker, although simple in construction, is oftentimes unreliable in operation on circuits with fluctuations sufficient to cause the plunger of the solenoid to be sucked up, but not sufficient to trip the circuit-breaker. Thus, for instance, if a certain current is sufficient to draw the plunger up to a certain position, the higher the plunger goes the less the amount of current necessary to keep it in that position, because as the plunger ascends the magnetic reluctance decreases and the voltage drop increases. If the current in the controlled-circuit drops again to normal, the plunger of the solenoid does not drop, but remains floating, so to speak, in the position it had before. A slight increase in the current is sufficient to cause the plunger to complete its upward travel, and as a consequence the circuit-breaker is tripped without any time element whatsoever. For this reason, devices depending on solenoids are not ideal for use with trip coils, and it has been suggested that electromagnets which attain their maximum power with a given current and thereafter gain but little strength with increase of current are preferable for this purpose.

A method of imparting a time element to trip coils on circuit-breaker which possesses in addition to the advantage of cheapness, simplicity and reliability, is to shunt the trip coil by means of a fuse. The scheme is, of course, only applicable to alternating-current circuits, depending on the impedance of the trip coil to force the current across the easier path through the fuse. The time taken by the fuse to blow, of course, gives the time element. By altering the size of the fuse, the time element can be decreased or lengthened at will. In practice the secondary current of the series transformer passes through the trip coil; but if a fuse is shunted across this circuit, the current will pass through the fuse, and, when the latter blows, through the trip coil. The arrangement has its drawbacks, but on motor-control panels it should prove very serviceable.

Service Connections.

A service from an underground system is understood to be the connection from the street mains of the electric light company to a point just inside the building line, and a service from an overhead system is usually understood to be the connection from the pole line or pole transformer to a service bracket erected on the building or to a point within the attic of a building, if entrance is made at such point. Very often electric light companies are requested to run their wires for some distance beyond the points specified, and in a number of instances where there are good reasons for so doing, the company seldom objects, provided proper steps are taken to safeguard the circuit from what would ordinarily be considered the service entrance to the meter board. In this connection the requirements of some of the large companies on such matters may be of service to some of the smaller companies and also to electrical contractors—to the former as showing what is done under certain conditions and to the latter as showing what to expect.

Unless provided for by contract with the company, it is usual to run only one service into each building for lamps and motor installations and all house mains are so arranged. In large buildings, lofts, halls, theaters, etc., where more than one service is necessary, the electric light company usually fixes the number of services it will run and specifies the meter connections. If the meter board and main switch are not erected just at the point of entrance of the service wires, and where more than one house circuit terminates at the service end, the electric light company will sometimes install an enclosed service switch arranged to cut out all the circuits in the building. In all cases, therefore, where mains are run between the point of entrance of the service wires and the meter board, the conduit must be terminated in such position as to permit of the erection of the switch box, the details of which are specified by the lighting company.

Since the point of entrance of the service or the location of the service bracket depends largely on local conditions of distribution, it is best to consult the electric light company on this point before the house wiring is completed. In underground systems the service is terminated just inside the building line and the cut-outs and meters are located at this point. The connections between the service end and the service cut-out and meters are made by the electric light company if they are not too long, say, 10 ft. or less. If, for lack of space or other reasons, it is impossible to install the meter within the limit set, it is usual for the company to request the customer to extend a main from the service end to the meter board, the location of which is subject to the approval of the company's inspector. All the connections between the service end and the meter board must be run in iron conduit.

Where the service entrance is overhead, the connections from the bracket on the building to the meter board in the cellar or basement are run in iron conduit properly equipped with entrance bushings. Where no basement or cellar exists the meter board is installed on the first floor, or if a customer so desires the meter can be located on this floor, in buildings with cellars, the location, of course, being subject to the approval of the inspector. In buildings three or more stories high, the service bracket is usually secured to the wall between the second and third floors, or if the building is two stories high or less, the bracket is secured to the wall as close to the cornice as practicable.

Where the entire block is supplied with electrical energy, the service wires are sometimes carried along the entire block on brackets secured to the rear walls and the connections are brought down to the cellar as before. In residential sections the service is sometimes brought down from the pole and run underground, the service being run in conduit through each of the premises. An outlet is provided in each house at which the house wiring is terminated, provided the underwriters approve of the arrangement.

As a rule companies in large cities will not carry their service wires over roofs, nor will they connect them to leads brought out through window frames, over doorways, or under show-window cornices. Where individual services are introduced underground from the pole, the electric light company runs its wires in conduit down the pole and into the cellar of the building just as though the service were entirely underground; but it is usual for the customer to bear the expense of such work.

Where large installations require electrical energy, primary wires are run underground to transformers located in a fireproof vault at the point of entrance of the primary wires, if the service be alternating current. Every part of the vault must be fireproof, including the door, and the vault must in addition be provided with means for ventilation into a flue or the open air. The vaults are usually built at the expense of the customer and are best placed directly outside the building so as to avoid fire hazard and needless complications with the underwriters. In many cases transformers are placed on poles and

the secondary circuits brought into the building. Where the transformers are large the poles are specially braced or a platform is provided for holding the transformers.

The Absorption-of-Light Method of Calculating Illumination.

By A. S. McAllister.

During the last few years several methods have been developed for determining the illumination upon a chosen plane directly from the value of the lumens generated by the lighting equipment, in order to eliminate the complications involved when the value of foot-candles is determined by the relation between the candle-power and the distance. The so-called "flux-of-light" method which has been applied with considerable success is based upon the initial silently-implied assumption that all of the lumens generated reach the chosen illuminated plane, and a certain "factor" is used to take into consideration the light that falls upon other planes and is partly reflected to the desired plane. This method would yield accurate results if all of the conditions governing the value of the above factor in each case could be chosen in conformity with the conditions prevailing when the experimental factor was observed. However, the relations connected with reflection and counter-reflection are so very complex that a factor which is correct in one case may lead to serious error when applied in another case where the conditions are somewhat different.

Theoretical consideration and experimental observations show that when a lighting unit radiating equally in all directions is placed at the center of a sphere whose inner surface possesses a light-reflecting coefficient, k, the effective illumination over the surface of the sphere has a value of $1 \div (1 - k)$ as compared with the value of 1 for a surface whose reflecting coefficient is zero. The relation here expressed has been found convenient in determining the characteristics of the integrating sphere used in photometry, but it is claimed that it can not be applied in determining the inter-reflections from the wall, ceiling and floor of a room not spherical in shape and having a non-uniform coefficient of reflection. The present writer believes that a more useful relation is that connected with the *absorption of light* rather than the reflection. That is to say, quite independent of reflection and counter-reflection, the lighting units within a room must produce the *sum of the lumens absorbed* by the various surfaces. From this relation one can readily determine the total lumens to be generated in order to produce a certain incident illumination, because for each surface there is a direct ratio between the absorbed and the incident lumens. The above relation can be expressed as follows:

$$\Psi = \alpha \beta A$$

where

Ψ = total lumens absorbed by the surface,
α = light-absorption coefficient $= (1 - k)$,
β = average incident light flux density in foot-candles,
A = area of surface in square feet.

A practical application of the above formula will render its meaning clear. Assume that a room 10 ft. wide by 15 ft. long by 8 ft. high, having a white ceiling, light walls and dark floor, is to be so lighted that the average total incident ceiling illumination is 1 foot-candle, the incident wall illumination 2 foot-candles and the incident floor illumination 3 foot-candles, and by means of the above relation determine the required candle-power. Assume, further, a light-absorption coefficient of 0.20 for the ceiling, 0.50 for the walls and 0.90 for the floor. The lumens absorbed by the various surfaces will be as follows:

Ceiling $= 0.20 \times 1 \times 150 = 30.$
Walls $= 0.50 \times 2 \times 400 = 400.$
Floors $= 0.90 \times 3 \times 150 = 405.$

Total lumens $= 835.$

Required mean spherical candle-power $= 835 \div 4\pi = 66.3.$

Some interesting facts can be noted from the above example. For instance, the walls and ceiling absorb more than half of the light flux produced. However, the total incident lumens on the floor reach 450, which is equal to slightly more than half of the amount generated. The total incident flux on the ceiling is 150 lumens, and on the walls 800 lumens. Hence, on account of reflection and counter-reflection, the generated lumens of 835 appear as $150 + 800 + 450 = 1400$ effective in illuminating the six surfaces.

Although the above example, which is based on certain arbitrarily chosen constants, does not represent any actual installation, and the method here outlined cannot always be applied with the degree of simplicity indicated above, yet it is believed that the method possesses some merit from a theoretical point of view, and it is hoped that it may prove of value in practical application.

Incidentally it may be mentioned that the only assumption affecting the accuracy of the results obtained by the above method are those relating to the absorption of light by ceiling, wall and floor coverings of various fabrics and color combinations, and to the distribution of light flux. Knowledge concerning light absorption is not complete, but much is known about the absorption of light by the fabrics usually employed in rooms. The distribution of light flux depends both upon the arrangement of the illuminants and upon the reflecting surfaces, and hence difficulty would be encountered in assigning exact values to the distribution. However, the calculations are based on the average flux density over only three different areas in each room and the conditions are such that a large variation in distribution of illumination from the assumed average values may produce only a moderate error in the final results. In any event, the method should yield results much more accurate than methods based on polar candle-power curves of the illuminants which neglect the reflections from the ceiling, walls and floor, and it should be subject to fewer errors than the flux-of-light method, which tacitly assumes average values for the reflections.

A word of caution should here be interposed. The method allows one readily to determine the value of lumens required to produce a certain desired illumination on chosen surfaces, but it should not be assumed that any lighting equipment which affords the required lumens will produce the desired illumination, because the distribution of light flux may be such as to supply an excess of illumination at some points and a deficiency at others. The method shows merely the value of lumens that must be generated by the lamps when the lighting equipment is so designed as to afford the specific distribution of flux. It gives no clue as to the distribution, which distribution must be ascertained from other considerations.

It is instructive to apply the above method to the calculation of the illumination produced within an integrating photometric sphere. Let the internal area be 10 sq. ft., the incident light flux density be 25 foot-candles and the absorption coefficient be 0.20. The absorbed lumens will be $0.20 \times 25 \times 10 = 50$, thus requiring about 4 cp. The total incident light flux being 250 lumens, the multiplication factor is 5—a value which would be obtained from substituting 0.80 for k in the expression $1 \div (1 - k)$. Thus, the method is applicable to homogeneous spherical surfaces as well as to non-homogeneous plane surfaces.

New Telephone Patents.

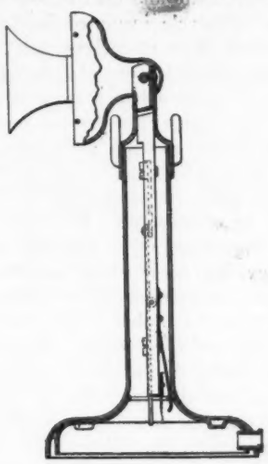
REVERTING BUSY TEST.

Wherever that system of party line operating is used in which a separate multiple number is assigned to each party line station, there is required to overcome errors, a special busy test. It will be understood that with this system there is nothing to distinguish a call from one station to another upon its own line. Thus when the operator tests the called multiple number, she finds it, under the ordinary test, busy, because of the presence of her own plug in the answering jack. A special counteracting busy test is therefore required. This is usually

a superimposed tone. It must be applied, of course, by means of circuits especially designed for the particular system used. C. S. Winston has recently patented an arrangement suitable for use with a two-wire system, his patent being assigned to the Kellogg Switchboard & Supply Company.

SUBSTATION APPARATUS.

In the cut is shown in section a deskstand set patented by R. H. Manson, the patent being assigned to the Dean Electric Company. There are a number of novel features. The set is made up of sheet steel, drawn and pressed into shape. The stem tube and base piece are one piece. A cap piece with ears



MANSON DESK SET.

for the hinge device, and of one piece, caps the tube. The transmitter casing is drawn out to the rear, and has an opening arranged to fit down over the top of the cap piece. Within the stem, a U-section hook support is arranged, its top end fitting snugly the cap piece, and its side flanges serving as auxiliary hinge wings. When the hinge bolt is put in place, the whole cap, transmitter casing and hook support are secured together. It is thus only necessary to lock the hook support in the vertical tube to completely secure all parts in position.

Messrs. F. C. Tabler, of St. Louis, Mo., and M. S. Hufschmidt, of San Francisco, have each invented and patented a transmitter antiseptic device. That of the former takes the form of an annular box. This box carries a lip on one side threaded to engage the usual mouthpiece orifice of the transmitter, while on its other face it carries a threaded socket to receive the mouthpiece. The box contains the antiseptic. According to Mr. Hufschmidt's arrangement the transmitter mouthpiece is lined with felt and it has at its base a perforated diaphragm of felt held in position by a perforated metal disk.

LOUD-SPEAKING APPARATUS.

A multiple transmitter and a loud-speaking receiver form the subjects of two patents granted jointly to Messrs. A. G. Kaufman and L. J. Lippman, of New York City. Five transmitter mouthpieces are mounted upon a single base piece, and these are so bent that the planes of the lips of the mouthpieces are tangent to the same sphere. An adjustable guide ring is placed before the mouthpieces to position properly the speaker's mouth. The transmitters each have a diaphragm carrying upon it the mica-lined felt washer of the microphone button, and also one electrode. Secured to it are also spherical buttons which project into the carbon space, registering in position with depressions in the rear electrode. These serve as agitators. The whole microphone button is held together by the pressure of a spiral spring surrounding the movable part and bearing against the felt washer. The loud speaker has a horse-shoe magnet, secured to a base block at its yoke end, the limbs lying parallel to the baseboard. Mounted with cores at right angles to the legs are the spools, projecting forward through a casing built upon the base and covering the magnet. The spool cores carry a flanged ring, upon which a conical diaphragm support screws, and from the front of this support the horn or megaphone projects. Adjustment is effected by screwing the diaphragm support more or less upon the flange. All working parts are, it is seen, supported from the magnet poles alone and thus there is little tendency to get out of adjustment.

AUTOMATIC RINGING CIRCUIT.

Where automatic or machine ringing is used, it is customary to arrange the circuits so that when the ringing of a subscriber is initiated either manually or automatically, the ringing will continue intermittently until either the call is abandoned or a response is obtained. In order to provide for the intermittent ring, the ringing current supply circuit is led through a commutator, and then through a trip device which responds to a heavy current, but fails upon normal current. The heavy current occurs when the receiver is off the hook at the called station.

It has been found that it is necessary to provide a direct-current supply rather than no current during the silent period, as this will also trip the cut-off device if the receiver be lifted during the silent period. Where this direct current is omitted, and the response is made during the silent period, it will be noted that the receiver may be applied to the ear and the latter subjected to a painful shock at the moment of connection of current at the commutator, followed by the almost simultaneous cut-off action. Mr. W. B. Davis, of Chicago, has obtained a patent for this double-current system, which patent is assigned to the Stromberg-Carlson Telephone Manufacturing Company.

LETTERS TO THE EDITORS.

Efficiency of Nernst Lamps.

To the Editors of Electrical World:

SIRS:—Referring to our communication on page 857 of the Oct. 17, 1908, ELECTRICAL WORLD, on "The Efficiencies of Nernst Lamps," we have been informed since that communication left our hands that the Westinghouse hollow-glower Nernst lamp, brought out Aug. 1, 1908, had a higher efficiency than the 110-watt hollow-glower previously manufactured by the Nernst Lamp Company. The figures we gave therefore should apply only to the 110-watt hollow single-glower put out previous to Aug. 1, 1908. The improvement in efficiency of the Westinghouse hollow single-glower, according to information furnished us by the Nernst Lamp Company, is about 12 per cent over the previous 110-watt hollow-glower lamp.

J. R. CRAVATH.
V. R. LANSINGH.

Tuning-Fork Slip-Meter.

To the Editors of Electrical World:

SIRS:—The article by Prof. Perkins which appeared in the issue of the ELECTRICAL WORLD for Oct. 31, on the "Measuring of Slip and Speed of Induction Motors," proved of special interest to the writer, who has used the indicator devised by Prof. Perkins for obtaining the slip of induction motors while undergoing a brake test. This indicator proved very satisfactory, the only objections noticed being due to the spring breaking off at its point of support, which caused some inconvenience, especially when the break occurred during a test. The adoption of the tuning-fork in place of the vibrating strip would undoubtedly obviate this difficulty and improve the operation somewhat. The tuning-fork is recommended by Prof. Perkins also for regulating the speed of machines during alternating-current tests. This method of speed control has been found by the writer to be entirely satisfactory. While conducting some tests on certain iron alloys for very low magnetic densities and very high frequencies it was necessary to obtain a practically constant speed, and this was accomplished by the use of a standard tuning-fork mounted upon or in conjunction with a

sounder. As Prof. Perkins states, this method of control necessitates very finely divided regulating rheostats for the driving motors, but with some practice the speed can be held practically constant, the value being indicated by a high pitched sound from the tuning-fork.

ITHACA, N. Y. F. C. LORING.

Economical Electric Cooking Devices.

To the Editors of Electrical World:

SIRS:—The recent articles in the ELECTRICAL WORLD relative to electric heating and cooking have been of great interest to me and is a subject which I believe should interest all central stations and manufacturers of electric heating apparatus.

I believe it is perfectly feasible and practicable for a combination of electric heating unit and fireless cooker principles to be so made as to utilize electricity for cooking for household purposes in such a manner as to compare very favorably with the cost of cooking with gasoline or gas and to be less expensive than coal.

The writer made a simple experiment with a 10-in. disk stove and a home-made fireless cooker, with the result that a 3-lb. pork roast was thoroughly well cooked with the application of electricity to the hot plate of only 15 minutes, the energy consumption being 300 watt-hours.

The device consisted of a box made as the usual fireless cooker, packed inside with mineral wool, a disk stove set into the bottom of the box and thoroughly packed under the guard plate with mineral wool, a cylindrical piece of zinc 12 in. in diameter set over and around the stove and packed with insulation and the whole covered with zinc tightly tacked to the inner edge of the box. An opening cut into the cover permitted of the usual vessel being placed on the hot plate. When the cover was replaced an insulating pad was placed over it and the lid of the cooker closed and clasped, thus making the whole practically air tight and the heating unit thoroughly insulated and encased. Ample space was left for the circulation of the heated air inside so that the vessel was quickly and thoroughly heated.

It will readily be apparent that the disk stove or hot plate is not the most desirable heating unit for this class of work, owing to the heat developed being concentrated at the disk or plate. I believe that if open coil heating units were placed around a cylinder and openings left at the top and bottom so the heated air could circulate and then this device placed inside another cylinder or receptacle insulated in the fireless cooker, that it would be much more efficacious and would be a step in the right direction toward economic electric cooking. The whole device could be patterned to a considerable extent after the newer style of gas range, the present burners being considered as representing the cooking receptacles, and the whole made of steel and fireproof.

There are many details in connection with such a device that would have to be worked out. It would be necessary to make them as nearly automatic as possible so that when an article was placed within for cooking and the circuit closed and left on indefinitely unintentionally, no damage would occur either to the food or to the cooker. This means that thermostatic cut-outs and time switches would need to be substantially and economically embodied in the construction.

As a central-station man the writer has not the time or facilities for working out these details. They belong properly to the heating apparatus manufacturers. I am sure that I voice the opinion of many operators who will gladly welcome a device of this kind to assist in building up the day load, and which can be placed before the householder at a popular price.

STERLING, COLO. O. P. SELLS.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Voltage Variation in Rotary Converters.—F. D. NEWBURY.—The direct-current voltage of a rotary converter can be changed by varying the impressed collector-ring voltage or by altering the shape of the magnetic field set up by the field windings of the converter. The first of these principles may employ reaction coils and variable field excitation or the method of C. F. Scott, which involves the use of a synchronous alternating-current booster mounted on the same shaft as the converter armature and connected, electrically, in series with it. The second principle—that of change of magnetic field—is used in the new split-pole converter. The author traces briefly the development of the methods of commutator voltage variation involving a change in the collector-ring voltage and compares more fully the booster method, as the latest and most promising of these methods, with the split-pole method. One point brought out by him in the discussion of the split-pole converter and again emphasized in editorial notes by P. M. Lincoln is that this machine must depend, for variation in the ratio between impressed and delivered voltage, entirely upon the introduction in its field form of harmonics of the same order as the phase of the generating system to which the machine is attached. For instance, in a three-phase system all changes in ratio must be those caused by the introduction into the field form of the converter of a third harmonic or multiple thereof. All harmonic fields of other orders are practically wiped out by circulating currents. Since nearly all generating systems are three-phase, it follows that change in ratio must be caused by the introduction of third harmonics into the converter field. This consideration indicates one marked superiority of the three-part pole machine over the two-part type. Both types arrive at practically the same results so far as changing the ratio is concerned, but in the latter type considerable circulating current must exist owing to the fact that the two-part field construction necessarily causes many harmonics other than the third to be introduced into the field form. The construction of the three-part pole machine, on the other hand, may be such that practically none but third harmonics need be introduced into the field form. The conclusion of the author is that "the split-pole converter does not accomplish any new thing, nor does it do old things more conveniently, more economically, or with less first cost than existing apparatus."—*Elec. Jour.*, November.

Efficiency of Direct-Current Machines.—W. LINKE.—According to the standardization rules of the German Association of Electrical Engineers the efficiency is to be determined from the no-load loss and the armature resistance. However, the no-load loss of a direct-current motor depends to a certain extent on the position of the brushes. An extreme case is shown in Fig. 1, which gives the results of tests of a 10-hp motor giving 19 amp full-load current at 440 volts, when running at 1150 r.p.m. When the brushes were displaced somewhat backward (about 1.6 segments, equal to 9 electric degrees), commutation was excellent and the motor ran without any sparks at full load, while at no load sparking was very slight. In this position, which is called the "motor position" of the brushes, the no-load current was 2.4 amp, corresponding to 1100 watts of no-load loss at 440 volts. When the brushes were advanced into the neutral position the no-load current was reduced to 1.3 amp, corresponding to a no-load loss of 580 watts. The difference of the no-load losses at the motor position and the neutral position of the brushes was, therefore, more than 500 watts; that is, about 6 per cent of the useful power of the motor. This difference is probably due entirely to Joulean-heat losses in the armature coils short-circuited by the brushes. It seems that

with the above motor the copper losses at full load are only about 300 watts. The final result is that in order to determine the efficiency from no-load loss and armature resistance, the no-load loss at the neutral position of the brushes is to be found. The value of the efficiency at any load ascertained in this way will correspond to the position of the brushes most favorable for this load. For constant position of the brushes of

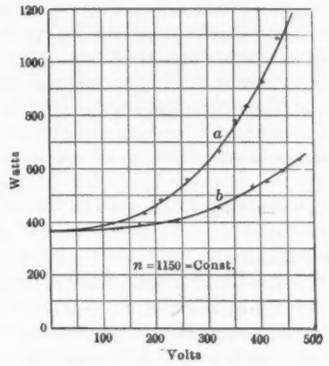


FIG. 1.—EFFICIENCY OF DIRECT-CURRENT MACHINES.

the motor and low load the efficiency found in this way may be considerably too high. An indication of the difference may be obtained from determining the no-load losses at the "motor" and the "neutral" positions of the brushes. The two curves in Fig. 1 represent the no-load loss as function of the voltage at constant normal speed, curve *a* relating to the "motor position" of the brushes, curve *b* to the "neutral position" of the brushes. Fig. 2 gives the curves of the efficiency as function of the power

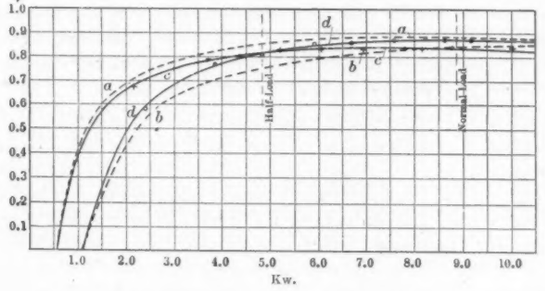


FIG. 2.—EFFICIENCY OF DIRECT-CURRENT MACHINES.

supplied in kilowatts. Curve *a* of Fig. 2 is the efficiency calculated from the losses on the basis of the minimum no-load loss of curve *b*, Fig. 1. Curve *b* of Fig. 2 is the efficiency calculated on the basis of the greater no-load loss of curve *a*, Fig. 1. Curves *c* and *d* of Fig. 2 give the efficiency directly measured at the "neutral position" and at the "motor position" of the brushes, respectively.

Double-Current Generator.—An illustrated description of a generating set exhibited at the Marseilles Exposition and to be used in a railway power plant in southern France. It consists of a water turbine coupled with a double-current generator. The latter produces direct current at from 800 to 850 volts and six-phase currents at 600 volts, with a frequency of 25. The rating is 850 kw.—*L'Industrie Elec.*, Oct. 25.

Lamps and Lighting.

Wiring for 25-Volt Lamps.—A. H. DYKES.—While it is probable that a satisfactory 200-volt metallic-filament lamp will be developed for use on 200-volt installations (usual in England), yet the low-pressure lamp will not only be mechanically stronger, but will be capable of being run safely at a higher efficiency, and these advantages alone will well repay the cost of the slight loss of energy in the transformer. The author makes a comparison between three different types of transformers which can be used. The first is a special auto-transformer, which consists of a single winding divided into a number of equal circuits. This is efficient and convenient whenever the lamps can be divided up into a number of groups, all of which are for use approximately at the same time. The second type is the plain auto-transformer. The third type is the ordinary transformer with two windings, and a distinction is made between the two cases whether the secondary supplies energy to a two-wire or a three-wire network. The chief results of the comparison are given in the following table, which refers to an installation with a maximum load on the secondary or low-tension side of 1000 watts; that is, 25 volts, 40 amp, the primary voltage being 200:

	No load losses of transformer in watts.	Full-load losses of transformer in watts.	Cost of transformer. shillings.
Balancer transformer.....	18 to 20	18 to 20 if balanced. / 28 to 30 if unbalanced	65
Auto-transformer	20 to 22	45 to 48	73
Transformer with two windings	24 / 14	54 / 44	81 / 108
Transformer with two windings, the secondary supplying energy to a three-wire system	24 / 14	51 / 41	73 / 91

For the two cases of the transformer with two windings figures are given for a more expensive high-efficiency transformer and for a less expensive and less efficient transformer. The great advantage of the transformer with two windings is the possibilities of using concentric wiring. By using a double-wound transformer where the secondary is entirely separate from the general system of distributing mains, it is possible to earth one pole of the secondary and use concentric wiring with an uninsulated return, thus saving half the insulated wire, half the fuses, and securing practically absolute immunity from shock or leakage currents. A very convenient system which the author has adopted is to run the wiring in tinned-brass tubing, using a single insulated wire and the brass tube as the return or insulated outer. A further improvement is to make the secondary winding two sections of 25 volts each, one each side of a three-wire system, with the middle point earthed. On this system each three-wire circuit consists of two insulated wires in one tube, the tube being the neutral or earthed conductor, and the lamps being connected between either wire and the brass tube. The ordinary fittings, plugs, holders, ceiling rosettes, etc., are used, one terminal of the plug or ceiling rosette being earthed on to the outlet-box. In this way one secures all the advantages of 50-volt distribution, while no portion of the circuit is more than 25 volts above earth; there is no possible chance of stray currents, the risk of fire is reduced to a minimum, and at the same time the amount of material required, and, therefore, the cost of the installation, is reduced to a low figure. A further improvement is to use a flexible concentric system with earthed outer, which can be quickly and easily cleated up to the walls and where the bare outer covering forms a protection to the insulated inner wire. Such a system appears to the author as likely to be the final solution of the cheap wiring problem.—Lond. *Elec. Eng'ing*, Oct. 29.

Time-Switch for Arc Lighting Circuits.—An illustrated description of the Venner time-switch made by an English com-

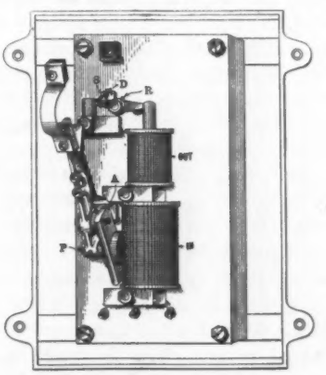


FIG. 3.—SWITCH.

pany for use on arc-lighting circuits, when half the lamps have to be switched off at midnight, and the arrangement of the

switch is such that a different half is switched off on alternate nights, so that all the lamps can be trimmed simultaneously. Fig. 3 shows the construction of the latest type of main switch constructed for purposes similar to this. The illustration represents a switch suitable for currents of from 30 to 150 amp. The two electromagnets "in" and "out" are connected to the circuits by the contact in the time-switch itself. When the electromagnet marked "in" is excited, its armature *A*, which is pivoted to *P*, is rotated until it lies parallel with the axis of the bobbin. As the switch is also pivoted at *P*, this action, which is, of course, very rapid, throws the switch in, the latter being caught and held by detent *D*, which is controlled by spring *S*. When the "out" solenoid is excited, the movement of its core, acting through the toggle piece pivoted at *R*, pulls up the detent and releases the switch, which is thrown out by the springs carrying the carbon contacts on which the final break is made. —Manchester Exhibition Supplement of Lond. *Elec. Eng'ing*, Oct. 29.

Photometer for Ultraviolet Rays.—J. Koehler.—A description of an apparatus for comparing two sources of light with respect to the intensity of violet rays. The two sources of light are so adjusted with respect to the Bunsen photometer that the grease spot on the screen of the photometer disappears. Both sides are then equally illuminated. The screen is then removed and a spark gap substituted for it. Hertz has shown that ultraviolet rays facilitate the spark discharge. The distance of lamps from the spark gap is then so adjusted that it is just above that distance through which the ultraviolet rays are effective in starting the spark discharge. Instead of adjusting the distances of the lamps from the spark gap, it is possible to adjust the candle-power of the lamps.—*Zeit. f. Beleucht.*, Oct. 20.

Generation, Transmission and Distribution.

French Power Stations.—An illustrated description of the Arles steam-turbine station which is intended to be used as a reserve for two water-power stations in the south of France, one of which supplies energy at 13,500 volts and 50,000 volts to three-phase networks with a frequency of 25 and the other to three-phase systems at 13,500 volts with a frequency of 50. The new reserve steam station has therefore to produce three-phase currents to two frequencies, namely, 25 and 50 cycles per second, and the former at two different voltages. The new station is equipped with three 1000-kw steam turbo-alternators. The frequency of two of the machines is 50 cycles per second, that of the third is 25. Transformers are provided for raising the e.m.f. to 50,000 and also frequency converters to change from a frequency of 50 to 25. Each of the frequency converters consists of a set of three transformers reducing the e.m.f. of the 25-cycle currents from 13,500 to 5500; a synchronous three-phase motor of 500 kw for a frequency of 25; an alternator for a frequency of 50 on the axle of the motor and of the same rating; a group of three transformers for raising the e.m.f. of the 50-cycle currents from 5500 to 13,500 volts, and a direct-current motor of 30 kw and 125 volts at the end of the axle of the motor-generator for use at starting and at synchronizing. —*La Revue Elec.*, Sept. 30.—A similar steam turbo-alternator at Arenc (Marseilles) is described in *La Revue Elec.*, Oct. 15. The Pinede (Marseilles) station, which supplies energy to the city of Marseilles, contains at present three steam turbo-alternators, generating three-phase currents at 5500 volts with a frequency of 50. The energy is transmitted partly to two transformer stations where the e.m.f. is reduced to 110 and 190 volts, and partly to a motor-generator station converting the three-phase currents to direct current for supplying energy to a 2-volt x 110-volt network.—*La Revue Elec.*, Oct. 30.

Electric Cranes.—H. H. Broughton.—A continuation of his long illustrated serial. In the present installment the author begins to deal with the design and construction of the structural steel framework of cranes. The first sections of the article are devoted to a consideration of the most suitable materials and working stresses. It is suggested that the Engineering Standards Committee's specifications for structural steel work should be adhered to by crane makers; also that the working stresses allowed be based on the nature of the forces acting and not upon some arbitrary factor of safety. Then follows a note on the determination of the stresses in the several members of frames of complicated shape. To assist designers, curves connecting weight and lifting capacity of English and German cranes are given. A number of typical examples of girder construction are also described.—Lond. *Electrician*, Oct. 30.

Electricity on Ship-board.—F. Thilo.—The conclusion of his illustrated article on various exhibits at the recent Navy Exhibition in Berlin. The exhibits described in this installment refer to signal systems, telephony on ship-board, transmission of compass readings (the main compass being placed at a point most favorable in magnetic resistance), wireless telegraphy and telephony, measurements of temperature at a distance, and miscellaneous applications of electricity on ship-board.—*Elek. Zeit.*, Oct. 29.

Energy Transmission by Endless Belts.—W. Beaumont.—An illustrated article in which the author draws attention to the necessity for increasing the frictional adhesion of belts on their pulleys and points out that more attention should be paid to the value of maximum distance between centers of driver and driven pulleys, and to minimum difference in diameters. In practice the coefficient of friction varies enormously, and insufficient attention is given to it, when the losses due to low coefficient of friction are considered. Not only are stronger and heavier belts used than should be necessary, but the very heavy tension put upon them increases the frictional losses and troubles with bearings and the losses caused in the bending and straightening of the belts as they take their bearing upon and leave the pulleys. Preparations for coating pulleys have been used, but these though quite successful for a time have been abandoned, apparently because of the necessity for renewal. Careful and persistent treatment of belts with castor oil or some preparation of oils has been most used, and in many cases of short belts and limited widths this has been forced upon users because otherwise the belts would not do the work required. Paper-covered pulleys or paper preparations for coating them have also been proposed.—Lond. *Elec. Rev.*, Oct. 30.

Cost of Energy.—Petri.—An abstract of a paper presented before the International Street and Interurban Railway Association on the economic importance of large generating stations on the development of interurban railways. The average figures of his statistics on the cost of producing electric energy for traction purposes in Belgium, France and Germany are as follows: For the companies generating their own energy the average cost per kw-hour is 2.2 cents, and for companies purchasing energy the average is 2.92 cents, the general average being 2.55 cents per kw-hour.—*Elec. Railway Jour.*, Nov. 7.

Traction.

International Street Railway Association.—An account of the proceedings of the recent Munich Convention of the International Street and Interurban Railway Association. A few of the papers presented have already been noticed in the Digest from European publications. However, this account appears to be the first complete one of the proceedings published anywhere. The matters under discussion were the economy of large generating stations; the use of independent motor-cars (gasolene, steam and electric); brakes; radial truck cars; lubrication; track construction; interurban railway practice; motor buses; rail corrugation and the use of watt-hour meters on cars.—*Elec. Railway Jour.*, Nov. 7.

Electric Operation of Swiss Railways.—W. Wyssling, L. Thormann and W. Kummer.—The Swiss Commission for Studying Electric Operation of Railways (W. Wyssling, general secretary) has discussed in No. 1 of its reports (mitteilungen) the total amount of electric power which would be required for the electric operation of the railways in Switzerland, if they were run in the same way (with the same acceleration, the same succession of trains, etc.) as they are now run by steam. However, in this way the especial advantages of the electric system would not be utilized. The commission has now studied the best condition of starting and stopping, composition of trains,

etc., for the electric operation of the Swiss standard-gage railways with grades up to 2.6 per cent. These investigations were carried out by L. Thormann. A summary of his results, prepared by W. Kummer, forms No. 2 of the Reports of the Commission. Concerning starting, the conclusion is reached that the maximum acceleration at starting should be 0.2 m per second per second for express trains, 0.3 m for ordinary passenger trains, and 0.1 m for freight trains. This means a considerable increase over the corresponding figures for steam traction, which are 0.1 m to 0.15 m per second per second for express and passenger trains, and 0.05 m to 01 m for freight trains. Concerning braking, the conclusion is reached that retardations of 0.5 m per second per second must be obtained with all passenger and express trains. The general formulas on which the above numerical results are based are also given. Concerning the permissible speeds the conclusions are as follows: The maximum speeds, now permitted with steam traction on trains with automatic train brake, are 90 km per hour, and on trains without automatic train brake 45 km per hour. Speeds higher than these should not be employed with electric traction, but the permissible speeds should be utilized as much as possible, and especially on grades the speeds employed should be higher than are now used. The maximum speed of ordinary passenger trains is assumed as about 75 km per hour. The following requirements are then specified: It should be possible to adjust the speed within as wide limits as possible. It must be possible to adhere to the schedule independently of the train weight. If first cost and cost of operation should not prove to be too high, it should be possible on grades up to 1 per cent to really maintain the maximum speed uniformly. On heavier grades the speed may be less. The overload-capacity of the driving motors should be such that in exceptional cases it should be possible to raise the speed up to the permitted maximum speed on grades. The succession of trains depends on the distance between stations or block signals. Three minutes seems the minimum interval at which trains should follow each other. A stopping time of 3 to 4 minutes is assumed for express trains, 1 to 2 minutes for passenger trains, 5 minutes for freight trains, and 6 to 10 more minutes for switching. Concerning permissible train-weight and train-composition, figures are given in comparison with present steam traction, but it is pointed out that with electric traction it is possible to run more trains without increasing essentially the cost of operation. With respect to the question of locomotives versus motor-cars it is said that the use of motor-cars is not feasible with freight trains, nor would they offer any essential advantages. Motor-cars could be used to advantage, however, on passenger trains and in many cases on express trains.—*Mitteilungen Schweiz. Studienkommission, No. 2.*

Single-Phase Traction.—A. W. COPLEY.—An article in which the author discusses the constants of single-phase railway circuits, especially the resistance of trolley and rail, the internal and external reactance, and the division of the current between rails and earth. The results are summed up in some tables reproduced from the author's discussion of Whitehead's A. I. E. E. paper.—*Elec. Jour.*, November.

Accumulator Cars of Prussian State Railways.—A fully illustrated description of the construction of the accumulator cars to be used on the German railway from Mayence to Münster. The weight of the car with passengers is 62 tons, the energy consumption at a speed of 45 km (27 miles) per hour is about 12 watt-hours per ton-kilometer. This includes the energy consumption of one start. The road on which this figure was obtained has some grades of 0.5 per cent and several sharp curves. —*Elek. Zeit.*, Oct. 29.

Brakes.—An abstract of three reports presented by Scholtes, Petit and Schorling on brakes for electric railways before the International Street and Interurban Railway Association. The following resolutions were finally adopted: "In selecting a car brake, all the conditions of operation should be taken into consideration and the application of any one of the systems—hand, electric or air brakes—may be justified. A car should be braked steadily, not intermittently. The equipment of the car should include two complete systems, independent of each other. The service brake should not require excessive muscular energy on the part of the motorman. When, on account of the weight of the cars, the grades, or the use of a number of trail cars, the hand brake is not reasonably adequate as a service brake, it is proper, according to the conditions, to use either an electric brake or an air brake, either of which can be considered as efficient and equivalent to the other.—*Elec. Railway Jour.*, Nov. 7.

Motor Buses.—OTTO.—An abstract of a report on auto-buses. The operating expenses in Berlin (including general expenses, administration, fuel, maintenance and insurance) were 20.4 cents per car-mile. This is the minimum cost with benzol fuel, if the cars are inspected regularly and carefully. According to Mariage the total expense of operation, including interest on capital, amounted to 0.64 cent per seat-mile on the Paris electric tramways, and to exactly twice this amount on the motor-buses. According to Kuhles the cost of operation of motor-buses in Munich was 30 cents per car-mile, while the cost of operation of tramways was only 10.8 cents per car-mile.—*Elec. Railway Jour.*, Nov. 7.

Installations, Systems and Appliances.

Design and Capital Cost.—M. WALKER.—A paper read before the Manchester section of the (British) Institution of Electrical Engineers. The author draws attention to the great importance of capital cost as regards its effect on the cost of electricity supply. Great reduction has taken place in the cost of electrical machinery of late years, and the author considers in what directions further reductions may be sought. The output is largely limited by temperature rise, which can be reduced by either the production of less heat or by better arrangements for carrying away the heat produced, methods for obtaining these ends being discussed by the author.—Lond. *Electrician*, Oct. 30.

Wires, Wiring and Conduits.

Protective Devices for Overhead Lines.—M. DAGUERRE.—A paper presented before the Electrical Congress of Marseilles describing various protective devices for overhead lines to become effective in case of a rupture of the wire.—*L'Industrie Elec.*, Oct. 25.

Electrophysics and Magnetism.

Electric Conduction in Metals.—J. KINSKY.—To test the electron theory of the conduction of electricity through metals, Riecke has formerly made the following experiment: He pressed an aluminum cylinder axially between two copper cylinders and sent a current through the three cylinders in series in order to see whether the current would carry any copper into the aluminum, or any aluminum into the copper. He continued his experiment for a year, passing altogether 958 amp-hours through the metals, and he failed to establish any evidence of material transport. The present author has repeated this experiment and has made several other similar experiments not only with metals but with alloys, but as far as the researches go he has not yet found any experimental evidence to demonstrate that the positive electrons take part in the conduction of electricity through metals or alloys. At any rate, the electricity does not appear to carry any material particles with it when flowing through metals and alloys.—Lond. *Eng'ing*, Oct. 30.

Radium Emanation in the Atmosphere.—J. SATTERLY.—An account of experiments made at Cambridge, England. The amount of radium emanation in the atmosphere near the earth's surface was measured by two methods: (1) absorption by charcoal, (2) condensation by liquid air, and the amounts compared with those given off by a radium solution of known strength. The two methods give results in fairly close agreement. They show that the amount of emanation in a cubic meter of air is subjected to considerable variation, and is, on the average, equal to the amount which would be in radioactive equilibrium with about 100×10^{-19} gr. of radium. No very definite correlation could be established between the changes in the amount of emanation in the atmosphere and changes in the

weather and barometer during the period through which the experiments were performed. The above quantity of radium emanation, together with its disintegration products, would produce about three ions per c.c. per sec. As the number of ions actually produced per c.c. per sec. is about 10 times this, it follows that only a small proportion of the natural ionization of the air is due to the presence of the radium emanation and its products.—*Phil. Mag.*, October.

Radium Emanation in the Atmosphere.—A. S. Eve.—An account of an investigation carried out at Montreal, Canada. The amount of radium which would be in equilibrium with the average amount of radium emanation present in a cubic meter of air, as measured at Montreal at intervals extending over a year, 1907-08, is 60 x 10^{-18} gr. The amount of radium emanation in the atmosphere varied so that the maximum is to the minimum as about 7 is to 1. The amounts in summer and in winter are not widely different, and large changes of temperature appear to have little or no direct influence on the quantity. The approach of a deep cyclone, accompanied by heavy rain or a quick thaw of snow, cause an increase, while anti-cyclonic conditions, with dry or very cold weather, give a decrease of the radium emanation in the air.—*Phil. Mag.*, October.

Secondary Roentgen Radiation.—C. G. Barkla and C. A. Sadler.—An account of an experimental investigation. Secondary Roentgen rays of two distinct types are emitted by substances subject to a beam of X-rays. One is a scattered radiation produced by the motion of electrons controlled by the electric force in the primary Roentgen pulses. The other is a homogeneous radiation characteristic of the element emitting it, and produced by the motion of electrons uncontrolled by the electric force in the primary pulses. All the phenomena of secondary X-rays thus far observed may be explained by means of these two.—*Phil. Mag.*, October.

Electrochemistry and Batteries.

Edison Battery.—K. Perlewitz.—An illustrated description of the type of the Edison nickel-iron battery, built in Germany for automobiles. The construction does not differ in any essential way from the American construction. The battery is built in the sizes given in the following table, which also gives dimensions, weights and watt-hours per kilogram:

Output in ampere-hours.	Normal current in amperes. Charge.	Discharge.	Dimensions in mm. Length.	Width.	Height.	Weight of total cell in kg.	Watt-hours per kg.
16	6	4	45	86	160	1.1	17.9
19	7.5	5	40	128	158	1.6	14.6
38	15	10	71	128	158	2.6	18.0
58	22	15	103	128	158	3.8	18.8
76	30	20	71	128	234	4.4	21.2
115	40	30	70	128	310	6.3	22.5
175	65	45	102	128	310	8.5	25.3
280	100	75	170	128	310	13.6	25.3

It is claimed that practice has shown that sudden heavy overloads do not injure the battery and that this fact counterbalances for automobile work the disadvantages of larger space and of higher price. The weight of an Edison battery for a freight automobile for two tons useful load is 575 km and the first cost 2980 marks. The corresponding figures for a lead battery are from 600 kg to 650 kg and 2200 marks. The Edison battery enables one to use iron tires, while with lead cells rubber tires are required with very high cost of maintenance. Tests during four years on automobiles have shown that Edison batteries when discharged once per day do not lose more than 15 per cent of their capacity within two years. For passenger automobiles which cover on 300 days per year daily about 75 km or per year 22,500 km (13,500 miles), the life of the battery is about 45,000 car-kilometers (27,000 car-miles). For freight automobiles which cover 50 km (30 miles) per day, the life is 30,000 km (18,000 miles). Even after that time the battery may still be used, but must be charged more often.—*Elek. Zeit.*, Oct. 29.

Units, Measurements and Instruments.

Sine-Wave Oscillator.—F. K. Vreeland.—An illustrated description of an apparatus designed to produce undamped electrical oscillations of pure sine-wave form, constant amplitude and constant, but readily controllable, frequency. The energy is derived from an ordinary direct-current lighting circuit, and the transformation into high-frequency alternating current is effected by a purely electrical method without the intervention of moving parts. The apparatus is said to be of the "organ-pipe type," because the process of transforming the continuous direct current into an undamped harmonic one is closely analogous to the phenomena which occur in an organ pipe. Free oscillations are set up in an electric oscillating circuit, and these oscillations are maintained at constant amplitude by continuously feeding energy into the circuit in synchronism with the oscillations to supply that lost in the circuit itself and in doing external work. The process consists briefly in causing the direct current to maintain an arc or stream of electrons forcibly ejected from a cathode, and causing this arc or stream of electrons to impinge on one or the other of two anodes constituting the positive terminals of the double arc. In shunt across these anodes is connected an oscillating circuit, comprising a capacity and a self-induction in series, and means are provided for deflecting the cathode blast so that it will impinge first on one anode and then on the other, thus applying a series of alternating impulses to the two terminals of the oscillating circuit. The frequency with which the arc is deflected is made to coincide with the natural frequency of the oscillating circuit by causing the deflection to be produced or controlled by the oscillations themselves, and in this manner energy is fed into the oscillating circuit in synchronism with the oscillations. To deflect an arc or "cathode blast" several methods may be used, two of which are described. In both of these the arc is deflected by a magnetic field, which in the one case is transverse, or normal to the

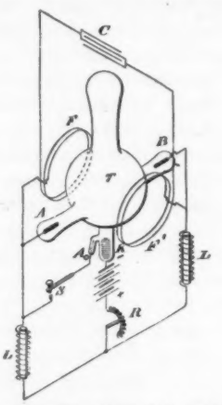


FIG. 4.—SINE-WAVE OSCILLATOR.

path of the current, and in the other case axial, or parallel to the flow of the current, but with the direction of its axis continously varying. The diagram, Fig. 4, shows the circuit connections of the transverse-field apparatus. *T* is a mercury-vapor tube having a single mercury cathode *K*, and the two carbon anodes *A, B*. This tube is connected across a source of direct current through a regulating rheostat at *R* and a pair of choke coils *L L'*, one in each anode branch. The oscillating circuit *A F C F' B* is shunted across the anodes *A B*, and comprises the condenser *C* and a pair of field coils *F F*. These coils are so placed as to embrace the body of the tube, which is spherical in form, so as to produce the necessary magnetic flux for deflecting the arc. The coils are placed with their axes perpendicular to the plane of the three electrodes of the tube, hence their field tends to deflect the electrons laterally in this plane. The choke coils *L L'* serve to maintain a constant current in the two anode branches, so that the current through the tube is normally divided equally between the two anodes. The transverse-field type above described is thought to be preferable to the axial-field type for ordinary laboratory purposes. The wave form produced is stated to be exceedingly pure.—*Phys. Rev.*, October.

Prepayment Meter.—A description of a prepayment meter of English make exhibited at the Manchester Exhibition. When a quarter is put in and the handle turned, a fairly heavy ball is raised and dropped into a beam with a V-shaped section. The weight of this ball overcomes the weight of a counterpoise and

pulls the beam up, closing a switch and thus connecting up the circuit. At the same time a small star-wheel which projects through a slit in the beam is put into gear with the counting train of the meter in its initial position. This wheel prevents the ball from rolling right to the end of the beam, but the wheel gradually rotates, corresponding to the quarter's worth of energy registered by the meter, and when it has made a one-fourth revolution the ball passes it and drops over the end of the beam back into a trough beneath, ready to be used again. Seven of these balls are provided with the meter so that seven quarters' worth of electrical energy can be prepaid.—Manchester Exhibition Supplement, Lond. *Elec. Eng'ing*, Oct. 29.

Demand Meter.—A description of the Lackie demand meter, which is used as an attachment to an ordinary meter. There is a small solenoid at the side of the meter, which lifts up a beam and puts the pinion carried by this beam into gear with a wheel on the one-hundredth unit spindle of the counter. The beam carries a small balance-weight, which is made to travel along the beam by the rotation of this pinion until it balances the pull of the magnet. The balance-weight carries a pointer which marks the maximum demand in amperes on a scale beneath it. The feature of the device is an arrangement for giving the meter a time-lag, so that the maximum currents are not recorded immediately. The usual lag is about 20 minutes, although this can be adjusted to any amount, and by this means short circuits, etc., do not prejudice the record of the maximum-demand part of the meter. This is effected as follows: Instead of the pinion gearing directly with the balance-weight, it causes an endless thread to travel along the length of the beam, and on this thread is a small blob. It takes a certain time for this thread to travel round and for the blob to engage with the balance-weight, and as soon as the beam balances, the thread is drawn back to its original position by a small hanging weight. —Manchester Exhibition Supplement, Lond. *Elec. Eng'ing*, Oct. 29.

Electrolytic Meter.—A description of a new electrolytic meter made by a British company. The electrolyte is shunted to a resistance in the main circuit, the drop of pressure in which at full load is 0.9 volt. The electrolyte of the meter is dilute sulphuric acid, which is sealed in a glass vessel together with two platinum electrodes coated with platinum black. The anode projects to some extent out of the electrolyte into an atmosphere of hydrogen, which is absorbed by the platinum black. When an electric current is passed through this vessel, the hydrogen absorbed by the anode combines with the oxygen which would otherwise be produced there, while an equal amount of hydrogen is deposited at the cathode. The deposited hydrogen rises into a vertical tube having a scale behind it, upon which its volume is measured. This, of course, is proportional to the ampere-hours, and the scale is graduated to show kw-hours at the supply voltage. When the measuring tube has become nearly filled with hydrogen (corresponding to, say, 300 kw-hours) the meter reader tilts it forward, and the meter is thus again started at zero. A new small and cheap type of this meter is being placed on the market for from 1½ amp to 3 amp; it is intended for very small installations, and also for fixing at the back of radiators or other portable apparatus.—Manchester Electrical Exhibition, Lond. *Elec. Eng'ing*, Oct. 29.

Measuring Frequency and Damping Factor of Oscillations.—An illustrated description of a method of O. Scheller for determining the frequency and damping factor of the oscillatory circuit in wireless telegraphy. The method is based on the plotting of resonance curves.—Lond. *Elec. Eng.*, Oct. 30.

Telegraphy, Telephony and Signals.

Telephone Exchanges.—A fully illustrated description of the new common-battery telephone exchange at Cardiff. Although it has been built for the Post Office, it will, until 1911, be operated by the National Telephone Company, a rental being paid by them to the Post Office. The present equipment consists of 112 three-position subscribers' sections, each operator's position having 120 lines, with provision for increasing to 150 if necessary. The multiple is fitted complete for 4600 lines, and the frameworks are arranged for 10,000 lines.—Lond. *Electrician*, Oct. 30.

Pot-Head Insulator.—An illustrated description of a combined pot-head and insulator for leading in telegraph wires. The lead-covered wire is brought up inside the first insulator, shown on the left of Fig. 5, through a hole in the top into a separate compartment, which is filled up solid with insulating material when

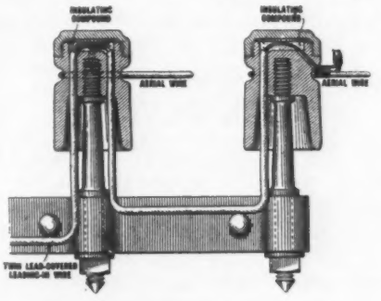


FIG. 5.—POT-HEAD INSULATORS.

the connection has been made. One of the wires of the pair is taken through the hole in the porcelain to the aerial wire, in the manner shown in the right-hand insulator, and the second wire is joined to another lead-covered cable, which goes up to the second insulator, and is led up in the same way.—Manchester Exhibition Supplement, Lond. *Elec. Eng'ing*, Oct. 29.

Wireless Telegraphy in a Certain Direction.—E. BELLINI AND A. TOSI.—Their complete (British) Physical Society paper, an abstract of which has already been noticed in the Digest. The first part deals with bilateral directive wireless telegraphy using closed oscillatory circuits: (i) for transmission; (ii) for reception; (iii) for both transmission and reception. In the second part the authors discuss their new unilateral directive method with the simultaneous use of closed oscillatory aerial circuits and the open oscillator or vertical antenna.—*Phil. Mag.*, October.

Miscellaneous.

International Electrotechnical Commission.—A full account of the recent conference in London. The organization of the commission was first taken up and the work done in different countries was reported. It is intended to draw up a glossary of electrical terms, not a complete dictionary, but rather to decide upon certain terms and their explanations which might be of use internationally. "The electrotechnical committee of each country should forthwith commence its work in nomenclature by preparing an electrotechnical glossary arranged in alphabetical order, in its own language. These terms, together with their explanations translated into the official languages of the commission (English and French), shall, as soon as the list for the first five letters (A-E) is completed, be forwarded to the central office for communication to the other electrotechnical committees. The same procedure shall be followed for the next five letters, and so on until the alphabet is completed. In carrying out this work each electrotechnical committee should, as far as practicable, utilize the work already done by others, to whom due credit should be given in each case." The metric system and its influence on the work of the commission were discussed. The following resolution from the Electrical Congress of Marseilles was considered: "The Third Section expresses the desire that this commission should study the advisability of general rules relating to interior wiring." This resolution was explained by Mr. C. O. Mailloux. It was agreed that, although this subject came within the reference of the commission, it was not one which could be carefully discussed at the present juncture, in view of the more important matters in hand which merited earlier consideration. The question of symbols was considered at some length, and an historical account of the subject was given by Prof. S. P. Thompson, being subsequently translated into French by Mr. Mailloux. The system advocated by Mr. Miles Walker, and referred to in ELECTRICAL WORLD previously, was explained to the delegates. Although everyone was interested in the idea of starting de novo

and inventing a new system of symbols, it was evident that it did not appeal strongly to the delegates as a practical solution of the problem. Finally, the chairman pointed out the enormous advantage which would be gained if Ohm's law alone could be expressed in the same symbols by all nations.—Lond. *Electrician*, Oct. 30.

Electric Syndicate in Germany.—An article on the alleged secret syndicate in the German electrical industry. Abstracts are given of a secret agreement between the large German electric manufacturers.—Lond. *Elec. Rev.*, Oct. 30.

BOOK REVIEWS.

Hendricks' Commercial Register of the United States, 1908. New York: Samuel E. Hendricks Company. 1240 pages. Price, $10.

The seventeenth annual edition of this valuable directory contains over 35,000 names and addresses and upward of 30,000 business classifications embracing material, machinery and apparatus of special interest to engineers, manufacturers and contractors. It is without doubt the most complete source of reference of its kind, and is remarkably accurate in its editing.

An excellent feature of the lists is the inclusion of trade names by which goods are frequently mentioned in specifications, and thus the contractor is enabled to learn the manufacturer of any given brand.

The Slide Rule. A Practical Manual. By Charles N. Pickworth. Eleventh edition. New York: D. Van Nostrand Company. 112 pages, 30 illustrations. Price, $1.

Though the slide-rule affords only approximate results, it is found to be of considerable help to some engineers and many draftsmen by the facility which it affords in processes involving multiplications and divisions. Some of the better forms of the instrument enable the operator to deal with algebraic and trigonometrical quantities with ease and rapidity and, at the same time, with sufficient accuracy for practical purposes. A glance over the pages of Mr. Pickworth's manual will show the wide range of problems that may be solved by the instrument. Numerous examples are given to illustrate each rule and to familiarize the student with the mode of application. The fact that this little work has reached its eleventh edition speaks well for its popularity among technical men.

A Pocket Book of Electric Lighting and Heating. By Sydney F. Walker, R.N. New York: The Norman W. Henley Publishing Company. 438 pages, 272 illustrations. Price, $3.

Of the text pages of this book, 360 are devoted to general electrical engineering, while only 40 pages treat of lighting and 15 pages of heat. The sections on lighting and heating are, however, inferior to the other sections of the work. It is apparent that the book was originally meant for an English circle of readers, as American conditions and products are almost entirely neglected. The General Electric Company mentioned is the English General Electric Company, which has no connection with the American company of the same name, and whose long lines of lighting and heating manufactures are not considered. The general make-up of the book, however, is excellent. The classification is clearly arranged and conspicuous, and much of the information contained is excellently presented.

Etat Actuel de la Science Electrique. By Devaux-Charbonnel. Paris: H. Dunod et E. Pinat. 650 pages, 346 illustrations. Price, 20 francs.

To some extent, this is a general treatise on electricity in which special attention is given to the presentation and discussion in a very able manner of such recent subjects as ionization, the electronic theory and the still perplexing phenomena of radio-activity.

Departing from customary methods, the author begins with a study of magnetic fields and the related phenomena of electromagnetism and electrodynamics. This study, lucid and unburdened with detail, is followed by an exposition of thermo-electricity with instruments and apparatus. The chemical effect comes next with considerations relating to the theory and action of primary and secondary batteries. Proportionate space and treatment are given to electromagnetic induction, to the elementary theory of the dynamo, motor and induction coil.

The second half of the volume opens with the processes of electric condensation and the theory of condensers, after which the author treats briefly of the development of electricity by contact with remarks on the efficiency of a few of the best known electrostatic machines.

In the field of applications, the actual employment and possible capabilities of the direct and alternating current are dwelt upon. The chapters on telegraphy, with and "without" wire, reveal the hand of a master on every page by thoroughness and originality, a fact explained by the long experience which the author has had as a leading telegraph engineer and professor in the Ecole Supérieure des Postes et Télégraphes.

The third part of this valuable text-book is devoted to general theory, including ions, emanations and all sorts of "rays." The order of treatment adopted by M. Devaux-Charbonnel while out of the usual, is commendable; phenomena first, then applications and finally theory. M. Poincaré contributes an interesting preface in which the ability of the author and the excellence of his work are duly recognized.

Hydro-Electric Practice. By H. von Schon. 1908. Philadelphia: J. B. Lippincott & Company. 382 pages, 140 illustrations. Price, $6.

This is an admirable work, although hardly justifying its title. The book has about as much hydraulics and as little electricity as some plants we could mention whose securities have only been floated by the heroic application of water power. There is a wearisome axiom attributed to Lord Kelvin that electrical engineering is nine-tenths mechanical engineering. Mr. von Schon has made this principle his own in regard to the subject matter of his treatise. The electricity is hard to find, but all the rest is good.

What we have just said is not a criticism at all derogatory to the work. It might probably depreciate in value if any of the water were squeezed out. Mr. von Schon, who has dealt with hydro-electric schemes for many years in an authoritative and successful fashion, is aware that the electrical end of most propositions brought up is all right; the trouble lies with the hydraulic conditions. Anyone who has been through New England and Pennsylvania, to say nothing of the Western States, during the past summer, when the river beds have been as free from moisture as the atmosphere of the moon, knows that the gaunt, rocky skeletons are exposed of many engineering failures. There was no ability to estimate or determine minimum flow, and there is revealed a disastrous lack of storage reservoir capacity. Mr. Edison once said, before he got into the game himself, that a ton of coal was the best storage battery he knew. Many a water-power plant just now approves his shrewdness, and looks with complacency on the storage represented by its coal pile. Many another plant is bewailing its fate, like the virgins without oil in their lamps. The autumnal rains come none too soon; and not a word of warning in this book as to minimum flow is superfluous. Some day it will be realized that President Roosevelt's vigorous outcry in behalf of the conservation of natural resources was a more patriotic service than all his vehement abuse of corporations.

Mr. von Schon presents the analysis and details of hydro-electric projects under the various sections of the market for power, the physical power conditions or opportunity, the cost of development, design and construction, types of structural work, plant and equipment. The text is direct and pertinent and all the diagrams and illustrations have a direct value, none being used merely for decorative effect, although the volume is a handsome specimen of bookmaking.

NEW APPARATUS AND APPLIANCES

Telephone Switchboard Building in Record-Breaking Time.

BY S. E. BROWN.

Commercially speechless—such was practically the condition in which thousands of business men of Paris found themselves on the morning of Sept. 21, 1908. Berlin, which the day before was at their elbows, now lay to the northward distant 600 miles; London, only a moment's time away 12 hours before, was now across the sea; and the provinces of France, which had lain within the shadow of the walls of the capital, now stretched silent from Alsace-Lorraine to the Pyrenees.

The burning of a single building in Paris—the great central telephone exchange—was what isolated and paralyzed her commercially. The fire of a few hours' duration ate up $6,000,000 of property, took the business district out of a single structure and spread it over a wide area and pushed the city back in history more than 20 years. Rob any city of to-day of its telephone system and it goes back to where it stood before the telephone became a commercial necessity. But what makes the modern city helpless when its telephone equipment is destroyed is that it cannot go back. The reason for this is that the telephone made the modern city possible. Try to imagine New York's skyscraper district without the telephone!

Business for one day in Paris was carried on by means of

FIG. 1.—VIEW OF BURNED 9000-LINE SWITCHBOARD, THIRD FLOOR, PARIS EXCHANGE.

what telegraph lines had not been ruined when the telephone building burned up—by messenger service, by special conveyance, by each and every method possible that would give a greater speed than mail. The next day saw an emergency telephone equipment caring for crippled business as best it could. Meanwhile hurried conferences were being held by the Paris telephone managers with the local representatives of an American manufacturing company relative to an equipment to take the place of that destroyed. For emergency equipments at best are but "first aids to the wounded," and are to be put aside as speedily as possible.

The building of equipment for a telephone exchange the size of the one destroyed requires time, and the people of Paris were clamoring for telephone service. This explains why the managers of the Paris telephone system immediately after the fire took their problem up with the largest manufacturers of telephone apparatus in the world. Speed was the controlling factor—speed and quality. The proposition put up to the Paris house of the Western Electric Company was a staggering one, but it had resources. It had local extensive facilities and back of them was the parent house in New York City, which in turn was backed by the company's Hawthorne plant just outside Chicago—the largest telephone manufacturing plant in the world, for which rush orders hold no terrors. When fire eliminated the telephone plant in Rio de Janeiro the cable had wildly called for apparatus. Hawthorne met the demand. Then early in the year Tokyo had called it to build material to take the place of a large shipment for Japan which had been lost when the steamship *Hohenfels* was destroyed by fire. This work was done in less time than Tokyo demanded. Sept. 22 Paris had the cabled reply that Hawthorne could furnish her part of the equipment complete in less than 30 days.

A diversion was created on the twenty-fourth by Paris asking

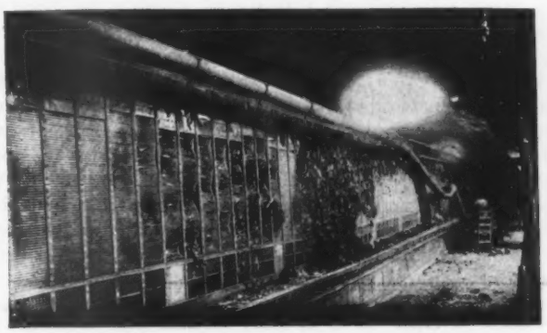


FIG. 2.—BURNED 10,000-LINE BOARD ON FOURTH FLOOR.

for switchboard cable, a request terminating a few days later in an order for 135,000 ft., which, by the way, is something more than 25 miles. The Western Electric Company, however, had the full amount of the size desired in stock and Hawthorne was ordered to ship it. But shipping cable by steamer differs from shipment by rail. The cable must be fully protected from salt water. Nevertheless the 25 miles of cable was unwound from reels, the ends paraffined, the cable rewound on

FIG. 3.—REAR VIEW OF FRAMEWORK OF NEW SWITCHBOARD FOR PARIS EXCHANGE.

reels, packed in waterproof cases and placed on cars in less than two days after receiving the order.

The most interesting fact brought out by the order, however, was not what the company did, but what it could do. The Paris order for cable, as before stated, was made up from stock. The Hawthorne plant offered to turn out twice that amount weekly from raw material. Meanwhile the superintendent of the switchboard department at Hawthorne had had more than a cable order to think about. On Sept. 29 the New York house telephoned to begin work on a switchboard, and cheerily informed him that the Paris branch had agreed to have the entire installation completed in 60 days and that a $600 daily penalty was attached to the contract. The information about the switchboard was pretty hazy. It was all the information New York could give, however, and all the Paris house could furnish; so the man at Hawthorne went as far as he possibly dared on his meager instructions, meanwhile won-

dering about the 60 days. He clearly understood about the $600 per day.

Oct. 3 brought information which was definite. Already a large amount of material had been lined up, and the moment the decisive word from Paris came, men trained to the minute in switchboard building began their tasks. In a trifle over three weeks after a definite order had been given by the managers of the telephone exchange in Paris, the finished switchboard stood at Hawthorne ready for shipment.

The same day that complete information was given Hawthorne a request was made for an estimate on the number of carloads and weight of the shipment. Reservation was made on a French Line steamer that sailed on Oct. 29, and arrangements were made with railroads that special attention be given the shipment. It was. The six carloads of material came from Chicago to New York in about two days.

The shipment from Hawthorne, together with a large amount of additional material which the New York house had manufactured, was shipped to Paris on the French Line steamer *La Provence*, that sailed from New York on Oct. 29. Thus only a few days more than a month elapsed from the date the fire occurred in Paris until a completed switchboard from the United States was on the sea—a switchboard, by the way, which stands 180 ft. long, requires 90 persons to operate, and will accommodate more than 10,000 subscribers. It may be of interest to know that it contains about 1,000,000 soldered connections and 3000 miles of wire. It is of some interest also to know that approximately 40,000 ft. of lumber were used in packing the completed board, and that 10,000 sq. ft. of paraffine paper was used in the cabling boxes alone.

A Controllable Non-Peak Load for Central Stations.

By Arthur J. Farnsworth.

Much has appeared in the technical press from time to time concerning day loads for small central lighting plants, and the improvement of station load factors from a purely electrical viewpoint. The present article, however, deals with a newly developed process in connection with an old-established industry that makes the latter radically different in regard to its desirability as a non-peak load. The ice-making process described below possesses certain advantages—both to the station man, who by it is enabled to greatly improve his load factor at the same time he is increasing his revenue, and to the manufacturer who can purchase energy at rates which will bring his cost of manufacture below competition. In certain instances, where the charter permits, the process will undoubtedly prove of interest also to operating companies, as a means of producing a lucrative by-product in connection with their regular business.

The present methods of making artificial ice by the can and plate systems are generally well understood. These processes differ considerably in regard to fixed charges and in the character of the product. Plate ice is dense and can be stored, but requires an expensive plant. Can ice will not stand storage without artificial refrigeration, and must, therefore, be made from day to day in varying quantities throughout the year, in accordance with the demand. Both the can and plate systems freeze slowly—the average time being, perhaps, two and one-half to three days for can ice and seven days for plate ice. They require energy steadily, and at as uniform a rate as possible, for the stoppage of the refrigerating machinery, with the resulting increase of temperature, is serious in proportion to the duration of such stoppage.

It is well known that ice is a poor conductor of heat, and that for given brine and water temperatures the ice is formed more and more slowly as it grows in thickness. It is, therefore, desirable to keep the temperature gradient between the brine and water as steep as can be, and to bring the water and freezing surfaces into the closest possible proximity. The "Centerfreeze" process of ice making has been developed to meet these conditions, and the results that have been obtained during the past year are said to be quite remarkable. Instead of the time formerly required, 11-in. ice, it is claimed, can be made in 18 hours. The ice produced is said to be dense and hard, as with the plate system, and can be stored as well as the latter, or as natural ice. The system also has several incidental advantages of importance, but to an operating company supplying such an industry with energy the chief interest in the process

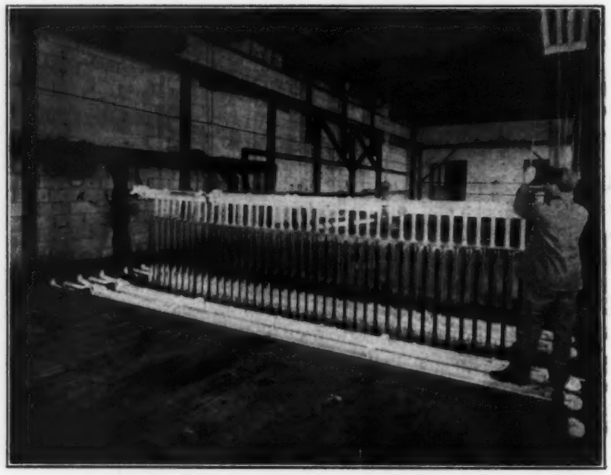


FIG. 1.—GRID WITH ICE CAKE BEING REMOVED FROM TANK.

undoubtedly lies in the fact that energy can be furnished in varying rates throughout the day, resulting in a great improvement of the station load curve.

The "Centerfreeze" process consists in forming ice upon a grid composed of parallel tinned steel or iron pipes connected at one end to a header, and leaving the other end closed and rounded. The header and freezing pipes are arranged with inner tubes to secure circulation of the brine, and the grid with its ice cake spans the freezing tank and rests upon the sides of the same. Connections between the grids and brine mains are made by readily detachable flexible couplings. Refrigerated brine is circulated through the grid, while about the depending pipes ice forms in cylinders, which as they grow larger unite with one another to form a cake of clear, solid ice. The cakes

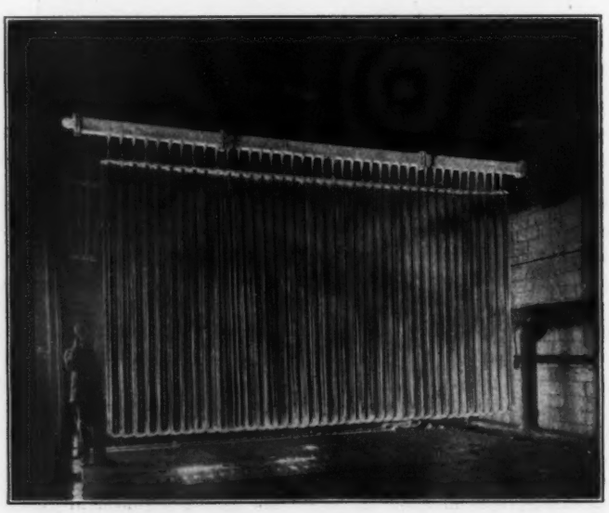


FIG. 2.—GRID AND ICE CAKE BEING MOVED TO TILTING TABLE.

of ice in any tank are wholly independent of one another and do not touch the tank, although they are formed side by side with but little space between them.

After the freezing has progressed to the desired thickness the ice is allowed to remain in the water for several hours to "temper," or to become of uniform temperature throughout, and thus avoid internal stresses that might result in fracture during

the process of harvesting. The grid with its ice cake is then lifted from the freezing tank, by means of a crane, and removed to a tilting table. Here the grid is connected to warm brine mains for a few minutes, until it becomes loosened from the ice cake, and is then pulled out of the latter and returned to the freezing tank to begin freezing another cake. Fig. 1 shows a "Centerfreeze" grid, with its attached ice cake, being

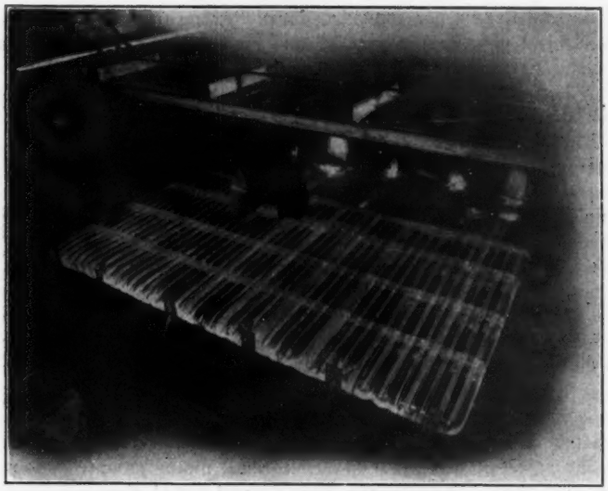


FIG. 3.—ICE CAKE BEING SAWED ON TILTING TABLE.

removed from the freezing tank and some of the features of construction and arrangement of the plant. The holes left in the ice cake by the removal of the grid are made by 1-in. pipes 5½ in. apart. These holes can be filled with water and frozen solid after the grid has been removed and before the cake is cut up. Experience has apparently proved, however, that the holes do not bring about any more rapid melting of the ice.

With this system the usual practice is to freeze cakes weighing from 2½ to 5 tons each, in reinforced concrete tanks, which may be lined with white enameled brick to render cleaning easy. The interiors of the tanks are entirely unobstructed when the grids are removed, and this fact, taken together with the brightly tinned freezing surfaces of the grids, makes the hygienic conditions excellent. The tank, or tanks, are of suffi-

FIG. 4.—ICE CAKE ON TILTING TABLE WITH PORTION REMOVED.

cient capacity for an average daily output only, the ice of each grid being harvested daily.

The rapid freezing of the "Centerfreeze" process is, of course, brought about by the steep temperature gradient between the freezing surfaces and the water, and also because of the small tank surface. With this system, in freezing an 11-in cake, for instance, the heat of the water has only to be withdrawn less than 5 in. through the ice to the cold-brine pipes, or less than half as far as in the plate system.

On a test made a few months ago on a 40-ton "Centerfreeze" plant in operation near New York it is claimed that 14 tons of ice were made on the average per ton of coal and that the factory cost of making ice in this size plant, with coal at $3 per ton, did not exceed $0.572. The entire cost of ice delivered on the platform at the plant is stated to be $1.153 per ton.

Depending on conditions it would be possible for an electric-light company to furnish energy to a plant of this kind in several ways, as, for instance, in the form of steam direct from the boilers of the power plant, in the form of electrical energy or possibly a combination of these two methods. The plant may start operation at any time during the evening, after the peak of the load is passed, and run continuously throughout the night and the next day until the peak comes on the following afternoon. The rate at which energy is absorbed by the ice-making apparatus need not be uniform, but may be made to conform to the available supply.

Electricity in Laundries.

BY G. CLIFFORD.

A few years ago the steam laundry was considered the last word, and it was a big advance over the early methods; but every year has brought its improvements in laundry methods and machinery until to-day the up-to-date laundry can turn out better finished work than ever before and the wear-and-tear on the goods has been reduced to a minimum. In the modern laundry electricity is widely used in lamps, motors and heaters, in all of which it has demonstrated its convenience and cleanliness. For lighting purposes the arc and incandescent lamp and their methods of installation are so well known that it is hardly necessary to dwell upon this portion of the laundry equipment. The light in a laundry must be good, particularly when work is done at night or when the laundry is located in a sub-basement, as often occurs in the flat-work laundries of large hotels and institutions or those on passenger steamers and warships, which latter are located in the hold where daylight does not penetrate. As the purpose of a laundry is to clean and iron garments and linen, the walls and ceiling are generally finished in white. In the most up-to-date laundries, the large commercial establishments and those of hotels and institutions, white enameled tile are often used. On shipboard the use of white enamel paint is advantageous. In the older establishments white paint is now used with a liberal hand, and has resulted in a great improvement of the interiors. Arc lamps are occasionally used in laundries for general illumination, but they are best adapted for the loading platform and the yard. The incandescent lamps, owing to the fact that they can be obtained in units of various sizes and the lamps can be so distributed that shadows are avoided, are usually employed in illuminating laundries. Nernst or metal-filament lamps can be used with great advantage and installed to suit the various machines. No general rule can be given for the distribution of these lamps, but it is desirable to have an intensity of illumination of from 7 to 10 foot-candles on the machines and at points where the goods are handled. This intense light is necessary owing to the fact that each article must be carefully inspected after each operation in order that imperfect work can be detected and turned back.

The individual motor drive, except on the finishing tables and possibly on the washing machines, is the most satisfactory method of handling the motor problem in laundries, although the group drive can be utilized for some machines. The use of motors eliminates the overhead shafting and belts, which are the source of a great deal of trouble, and from the view point of the laundry proprietor this trouble is a serious matter. Overhead shafts and belts accumulate dust and dirt, and on occasions the drip pans for the bearings overflow and a considerable portion of the laundry work must often be handled twice from this cause. The seriousness of the situation has resulted in several of the large commercial laundries investing large

sums to equip their machines with motor drives, in one case $10,000 was spent by a large laundry for this purpose. Laundry operations are intermittent, many of the machines are used only at intervals and others are in operation during only a portion of the working period, hence it can be appreciated that a considerable economy can be effected by a motor installation which consumes power during only the actual period of service. The motors required for this work are of comparatively small sizes, but there are a great many laundries, and their number is increasing, and for this reason the field offers great

FIG. 1.—HYDRO-EXTRACTOR DRIVEN BY VERTICAL-SHAFT MOTOR.

opportunities to the motor manufacturers who study its requirements. The character of the work is such that at the present day the direct-current motor is best suited for laundry service owing to the facility with which its speed can be controlled. Alternating-current motors can be utilized for some of the machines, but it will be some time in the future before the speed-controlling facilities of the direct-current motor can be equaled; and until that day arrives the most satisfactory method of driving a laundry from an alternating-current source of supply will be through the intervention of a motor-generator set, a rotary converter or possibly a mercury-vapor rectifier. The last two, however, are not as satisfactory as the motor-generator set. It is possible that the rectifier may be developed to a point where it furnishes a reliable method of conversion, self-starting, etc., but until such a rectifier equipment is placed on the market this method of conversion cannot well be used.

Washing machines are usually installed in the basement or on the first floor. These machines are usually rated by the number of shirts washed at a time and are built for from 40 to 400 shirts. These machines must be installed upon a concrete floor arranged with drains for disposing of the water from the machines and for handling the wet goods removed from them. The extractors for drying the goods are usually placed in front of the washers in order to concentrate the sloppy portion of the work in one place. The washing machines consist of two concentric cylinders, the outer is water-tight and stationary, while the inner is perforated and arranged to revolve, in which the goods to be washed are placed. When the goods are put in the machine, cold water is admitted and the machine started, live steam being then admitted. The individual motor drive is occasionally used for washing machines, but the group drive is generally favored. The inner cylinder revolves first in one direction, then in the other, and the reversing process consumes considerable energy. With the group-drive the motor will be smaller than the aggregate power of the motors required for the individual drive. In addition, the motor driving a group of washing machines can be so located that it will not be subjected to the dangers of having water slopped over it. Chains are often used for transmitting the torque from the motors to the lineshafts, and waterproof leather or rubber beltings are used between the lineshaft and the washers. Some washing machines are driven by a single belt with a geared reversing mechanism, and this method has proved satisfactory. This geared device is desirable when individually driven washing machines are used, but the belt drive is often employed.

With regard to the determination of power required by washing machines, a rule-of-thumb method is to allow 1.50 hp per 100-shirt rating of the washing machines for the individual drive and 1.25 hp per 100 shirts for the group drive. This rule works out very well in practice and gives ample power for the reversing mechanism. With the group drive this rule allows for the power in the lineshaft. The motors employed are usually of the compound-wound type.

The extractors, sometimes called hydro-extractors or centrifugals, are driven by series motors. For laundry work the extractors range from 20 in. to 30 in. in diameter of basket and run at a peripheral speed of from 5000 ft. to 6000 ft. per minute. These machines are used for a few minutes at a time and then are idle while the dried goods are removed and a wet batch placed in them. A rheostat and a double-pole switch are used for control purposes. The rheostat can be mounted on the curb of the extractor or upon a convenient post or on the motor pedestal, if one is used. There are several methods of applying the motor drive to extractors. According to the earliest type the motor was mounted on a pedestal in back of the extractor and drove the extractor through a quarter-turn belt. A later type of drive uses a vertical-shaft motor mounted upon an extension of the extractor bedplate and belted directly to the basket spindle. In the latest type of motor-driven extractor the motor is combined with the machine, the armature of the motor being mounted directly upon the spindle of the machine.

Tumblers are used to shake the goods out after they are removed from the extractors. These machines are similar to washing machines, and are used for the "flat work." They require about the same amount of power as does a washing machine of equal size.

Mangles, which are used for "flat work," are made in a num-

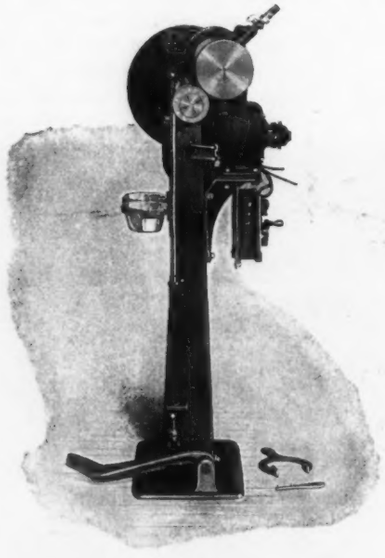


FIG. 2.—MOTOR-DRIVEN BAND IRONER.

ber of sizes, the smallest for handkerchiefs, the largest for heavy linens, damasks, etc. These machines require a controller giving one or two slow reverse speeds and varying the speeds for the working direction from 50 to 125 per cent of the normal motor speed by a combination of armature resistance and weakening the shunt-field current. Occasionally these controllers are equipped with an overload release, which is convenient in case the goods become stuck in the machine, as it prevents their being damaged.

Mangles usually have from one to three heated rolls, although

in some types there are one heated roll and four steam chests. The largest sizes, which are used for heavy "flat work," are intended to handle "work" fed to them very wet in order that a snow-white finish will be obtained and the figures on damask will show up raised. The "work" is conveyed through the machine by an apron, special feed guards being used in order to prevent the operators from getting their hands drawn in by the goods. The motors for mangles range in rating from 0.3 hp to 3.0 hp.

Starching machines are made in a variety of types for handling different kinds of goods. Collars and cuffs are starched either in drum machines, which dip the goods under the starch and wipe off the surplus, or in a barrel or dip-wheel starcher, which consists of a vessel in which the starch and the goods are placed, the machine working the starch thoroughly into the fabric by rotation. A shirt starcher consists of a starch vessel and rubbing frames which work the starch into the fabric by a reciprocating motion. Bosom starchers are designed to apply the starch to the bosoms of stiff shirts, leaving the rest of the garment free from starch. These machines are used in combination with band starchers, which are employed for working the starch into the neck bands and the sleeve bands. These machines are also used in applying starch to attached cuffs and collars. The motors required for these machines range from 0.125 hp to 0.5 hp. A regular starting rheostat is required as the speed of the motors is not varied. Starch extractors are similar to hydro-extractors, but are run at slower speeds. They are used on shirt waists and muslin underwear, which is starched throughout. The speed is adjusted to leave just the proper amount of starch in the goods. Series motors are used with these machines.

Dry rooms are of two types, cabinet dry rooms and conveyor dry rooms. In the former the goods are hung on racks and the air is circulated by means of fans, which require from 0.125 hp to 0.25 hp. The conveyor dry rooms are made in a variety of sizes, ranging from two to five loops of the conveyor, fans being used to circulate the air. The motors for this work are of slow-speed type, and speed regulators are used for controlling the speed of the conveyors.

A variety of ironing machines are built for handling collars and cuffs, bosom ironers for shirts, body ironers for shirt bodies, band ironers for sleeve and neck bands. The latest step in the ironing is the use of presses instead of the ironers. The

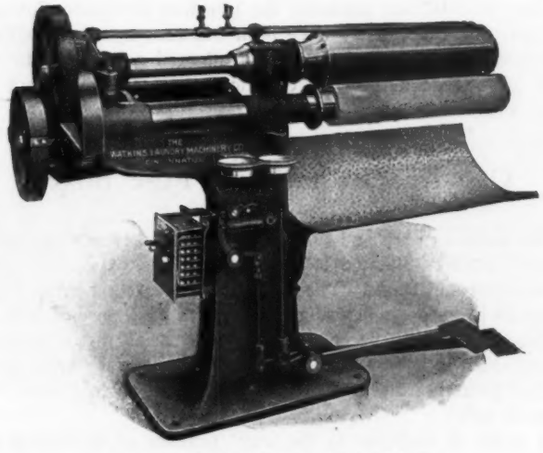


FIG. 3.—MOTOR-DRIVEN BODY IRONER.

finishing table, which is a device in which collars and cuffs are finished on the edges and in which turn-over collars are formed, is also motor driven. The motors used for these machines range in rating from 0.125 hp to 0.75 hp, and a variety of controlling devices are used. Most of the motors are designed for comparatively slow speeds.

One of the great advantages of the motor drive lies in the fact that the speed of the machine can be accurately adjusted to turn out the maximum quantity of work. The increase in output varies largely, less advantage in this line being attainable in a well-managed plant than in one where the supervision is slack. Increases of from 50 to 100 per cent in output have been attained by an intelligent study of the work when motor-driven machines were introduced. In some cases much greater increases in output have been secured, but only a portion of such gain is due to the use of motors.

In regard to the cost of equipping a laundry with motors, it is difficult to give any general rule. Approximately the cost can be estimated when the sizes of the motors are those suited

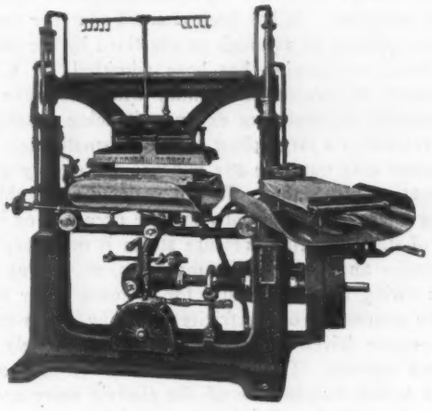


FIG. 4.—MOTOR-DRIVEN BOSOM PRESS.

for the ordinary commercial line of work by multiplying the aggregate horse-power required to operate the various machines by $160. This product will be the cost of the motors for individual motor drives and controlling apparatus. The following table, which is based upon practical work, gives the rating and speed of the motors required, together with the type of controlling devices used for the equipment of laundry machinery:

Machine.	HP. of motor.	Approximate speed of motor, r.p.m.	Kind of motor.	Controlling device.
20-in. hydro extractor	1.5	1,400	Series	Starting box
26-in. extractor	3.0	1,400	Series	Starting box
30-in. extractor	4.0	1,200	Series	Starting box
Mangle, 120- in.—				
Small, 3 rolls	1.0	900	Shunt	Variable speed
Small, 5 rolls	1.34	1,200	Shunt	Control with reverse speeds
Medium, 3 rolls	1.5	900	Shunt	One or two slow reverse speeds
Medium, 5 rolls	2.0	1,200	Shunt	
Large, 3 rolls	2.0	450	Shunt	Working speeds from 50 to 125% of normal
Large, 5 rolls	3.0	650	Shunt	
Handkerchief mangle	0.34	1,200	Shunt	Variable speed
Return apron mangle	0.75	750	Shunt	Armature and field resistance
Single roll mangle	0.25	750	Shunt	Speed regulator
Small mangle, 4 rolls	0.75	750	Shunt	Variable speed
Bosom starcher	0.25	1,000	Shunt	Starting box
Band starcher	0.125	1,000	Shunt	Switch
Shirt starcher	0.25	1,000	Shunt	Switch
Dip wheel starcher	0.50	600	Shunt	Starting box
C. & C. starcher	0.25	500	Shunt	Switch
Starch extractor	1.00	800	Series	Starting box
Cabinet dry room and conveyor dry room fans	0.25	200	Shunt	Switch
Dry room conveyor—				
2 loop	0.125	350	Shunt	Speed regulator
2½ loop	0.125	350	Shunt	Speed regulator
3 loop	0.25	450	Shunt	Speed regulator
3½ loop	0.25	450	Shunt	Speed regulator
4 loop	0.25	450	Shunt	Speed regulator
4½ loop	0.34	700	Shunt	Speed regulator
5 loop	0.34	700	Shunt	Speed regulator
C. & C. dampener	0.17	1,000	Shunt	Starting box
C. & C. ironer, 42 in.	0.75	750	Shunt	Variable speed
C. & C. ironer, 48 in.	0.75	750	Shunt	Speed regulator
C. & C. ironer, 24 in.	0.25	750	Shunt	Speed regulator
Combined ironer, 18 in.	0.25	750		
Bosom ironer, 17 in.	0.34	700	Shunt	Speed regulator Reversing switch
Bosom ironer, 10 in.	0.25	1,000	Shunt	Reversing switch
Bosom press	0.50	1,100	Series	Reversing switch
Reverse body ironer	0.50	600	Compound	Speed regulator Reversing switch
Body ironer, 36 in.	0.34	650	Compound	Speed regulator
Reverse sleeve ironer, 18 in.	0.25	1,000	Compound	Speed regulator Reversing switch
Sleeve ironer, 12 in.	0.25	1,000	Shunt	Speed regulator
Band ironer, 6 in.	0.125	1,000	Shunt	Switch
Cuff attached ironer	0.25	1,000	Compound	Speed regulator
Fluting machine	0.125	1,000	Shunt	Switch

Speed Regulator.—Denotes speed regulation by the insertion of resistance in series with the armature of the motor.

Variable Speed.—Denotes speed regulation from 50 to 125 per cent of normal by the use of resistance in series in the armature circuits for the low speed and by resistance in series with the shunt-field winding for the high speeds.

Starting Box.—Denotes the ordinary rheostat used with a shunt motor.

In the laundry many of the operations are intermittent and the electrically driven machine consumes power only during the time it is actually in operation. Reliable data in regard to the cost of electric operation as compared with mechanical operation are difficult to obtain. Few laundries care to disclose their cost of operation. It has been claimed that the cost of operation was reduced by as much as one-third by the use of motors, while smaller reduction has been admitted in a few cases. Necessarily the size of the laundry will have some effect upon the reduction in operating expense, it being possible to obtain better results in a large plant than in a small one. In fact, the small plant may not save any expense for energy and may find its operation bill higher. It will make considerable difference whether energy is generated upon the premises or bought from a central station. High-pressure steam is necessary for heating the mangles and the washing machines, as well as for the dry rooms; owing to the necessity for a steam boiler for this purpose the generation of electricity either by steam-engine driven or gas-engine driven generators adds comparatively little to the operating expense. The elimination of dirty belts and shafting and the added convenience of the electric drive are factors of no mean magnitude. On these grounds alone considerable expense will be justified.

Insulating Shields for Protecting Linemen.

The device shown in Fig. 1 is a flexible insulating "shield" designed for surrounding a "live" transmission line wire, tie wire and insulator at a pole in order that linemen may conduct repairs while the circuits are in operation at full e.m.f. The shield is built of pure Para rubber, varying in thickness from 3/8 in. where it is subjected to pressure to 3/16 in. along the flaps. The shape is such that when the shield is in place no "live" part of the circuit is within the danger range of the lineman. A hard rubber ring serves for clamping each end of the shield closely around the wire for holding the device securely in position. Each flap of the shield is provided with a handle so as to obviate the necessity of the lineman's placing his hand within the shield when placing it over a "live" wire.

FIG. 1.—VIEW OF RUBBER SHIELD, SHOWING RINGS FOR CLAMPING SHIELD IN POSITION.

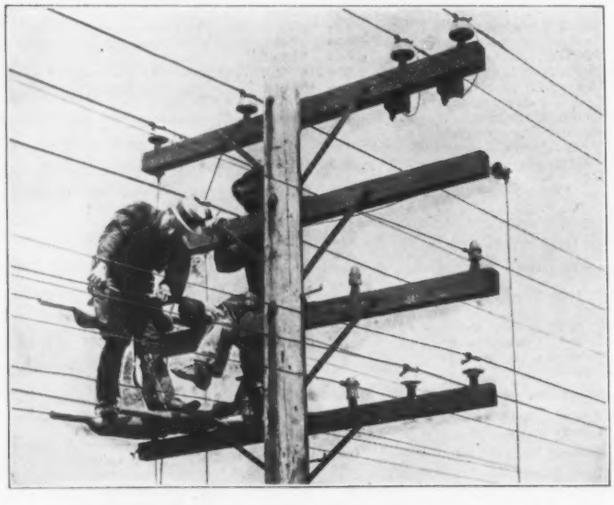


FIG. 2.—INSULATING SHIELDS IN ACTUAL USE.

It is stated that each shield is subjected to a water test at 30,000 volts. The shields are recommended for e.mf.s. not exceeding 7500 volts, although they are being employed at 10,000 volts during dry weather.

Figs. 2 and 3 show the shield in actual use. It is said that the three-phase circuit over which the shields are placed was in service at the normal e.m.f of 4600 volts when the photographs were being taken. Even when the lineman was working upon the wire, as shown in Fig. 3, the e.m.f. of 4600 volts was impressed upon the three-phase circuit of which this wire was a part.

FIG. 3.—INSULATING SHIELDS IN ACTUAL USE.

The "shields" are made by the Lineman Protector Company of Detroit, Mich. They have been indorsed by the Fidelity & Casualty Company, and have been adopted and placed in service by a large number of electric companies throughout the East and Middle West.

Cast-Iron Switch and Fuse Boxes.

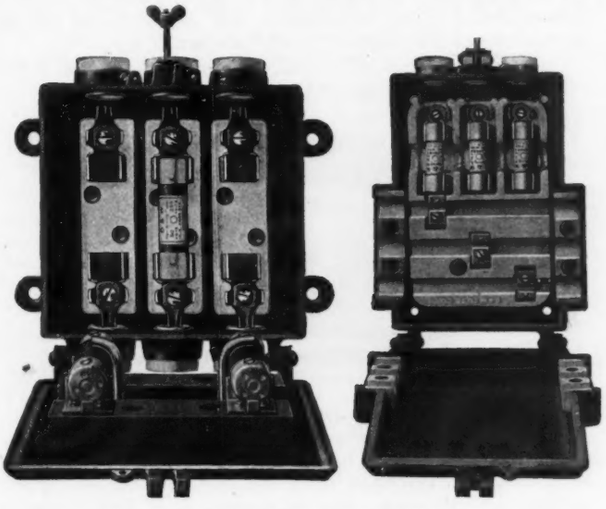
The service switch and fuse box illustrated herewith possesses several features claimed to be improvements over older types of switches and boxes. The fuse guides are so mounted in the cover as to be positively aligned in order that the box may be readily closed with the fuses properly engaging in the cut-outs. There are also mounted in the cover withdrawal hooks which by one-quarter turn on the outside of the cover remove the fuses at will.

In order to conform to the usual practice of grounding the neutral on a three-wire, direct-current system, the arrangement is such that the neutral fuse remains permanently in the box, thus avoiding any possibility of accident due to the fuse being withdrawn. For polyphase circuits where all fuses should be removed, the box is provided with three hooks operated simultaneously by one lever.

The fuse boxes are similar in general appearance to the service switches, but, being intended for use only as cut-outs, no switch mechanism is provided for in the covers; the fuses are directly mounted in the boxes.

The above-described devices have been placed on the market

by the D. & W. Fuse Company, Providence, R. I. This company has also developed a line of branch boxes, the special feature of which resides in the use of split bushings, mounted

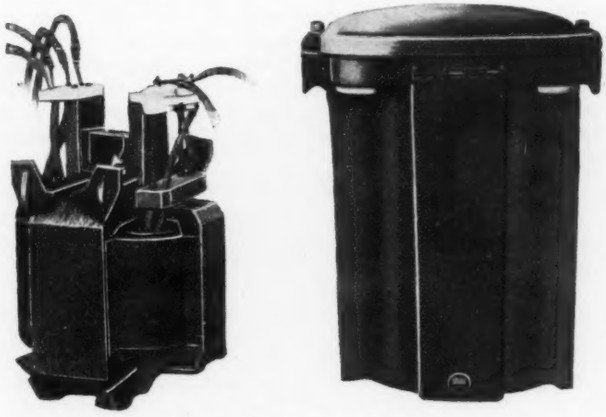


FIGS. 1 AND 2.—SWITCH AND FUSE BOXES.

in the cover, and in the use of boxes which permit the necessary connections to be made without break in the wire, thereby minimizing the cost of installation.

Transformer with Cruciform Core.

The accompanying illustration shows a type of transformer recently placed on the market by the Westinghouse Electric & Manufacturing Company. The magnetic circuit is of the cruciform variety and hence the transformer may be designated as of the combined shell and sore type. The coils are arranged similarly to those used with core-type transformers, the high-tension winding being mounted concentrically between two low-tension coils. The coils are former-wound and individually insulated. The conductors are covered with cotton; in small transformers round conductors are used, but in larger units copper straps are



CRUCIFORM TRANSFORMER CHOKE-COILS AND CASE.

employed. Between the high-tension and low-tension coils use is made of layers of paper and mica. After the coils and core are assembled, they are subjected to a vacuum treatment to remove moisture and air, and to impregnate the apparatus with an insulating compound. It is stated by the makers that the windings and insulation are formed into a solid, moisture-repelling unit.

The magnetic circuit of the transformer is built up of alloy sheet steel, the claim being made that this material has been selected only after an extensive series of tests proving it to have practically "non-aging" qualities.

Benjamin Ceiling Fixture Sub-Base.

A new sub-base for the attachment of clusters to ceiling outlet boxes has been brought out by the Benjamin Electric Manufacturing Company, of Chicago, and is illustrated in the accompanying Figs. 1 and 2. This sub-base is attached to the outlet box, serving as a cover. By means of rings on the

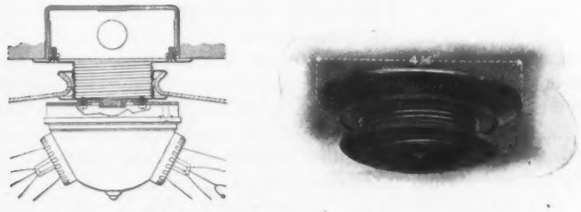
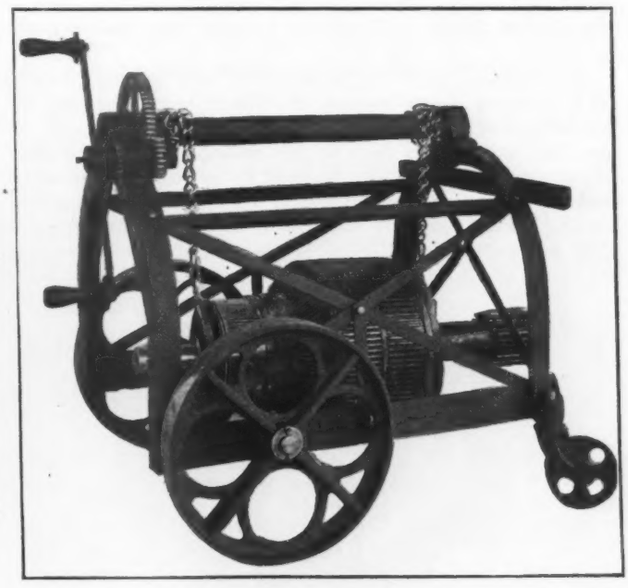


FIG. 1.—DIAGRAM OF SUB-BASE. FIG. 2.—SUB-BASE.

threaded portion, the reflector can be screwed firmly in place, and it is not necessary to use thumbscrews to hold the reflector. Fig. 1 is a cross-section, and Fig. 2 shows the two knurled threaded rings between which the reflector neck is held.

Improved Armature Truck.

The Device Improvement Company, Hanover, Pa., has recently modified its self-contained "Peerless" armature truck, the hoisting mechanism of which is part of the truck. By means of the tongue over the caster, the truck can be easily run over the armature to be handled, as the front end has only short braces which clear any railway armature in use. To raise the armature, the chains are lowered, the hooks are placed over the ends of the shaft and the dog is thrown into engagement



ARMATURE TRUCK.

with the ratchet and the handle revolved until the armature is raised far enough from the floor to insure clearance. As the back gear ratio is large, only a small pressure is needed on the handle to raise the heaviest armatures. The armature is then ready for transportation to the point of destination, the steering being accomplished easily by the tongue over the casters.

Contrasted with the usual practice in moving armatures which necessitates the services of several men and planks, blocks, etc., the truck saves labor, time and material, and the armature is not subject to any risk in handling. The front wheels of the

new truck are larger in diameter and of wider face, and are located nearer the center of the frame than in the old trucks, so that they take about 80 per cent of the weight of the armature; and the teeth on the back gearing are larger and heavier. The hooks and chains are also heavier and stronger. The elevating drum is of 2-in. extra heavy pipe. The truck is made of cast iron and steel adequately braced.

Flashing Sockets.

Encouraged by the success of their small thermostatic flashers operated on the principle discovered by Dr. C. O. Schneider, about five years ago, as embodied in the "Firefly" flasher, C. O. Schneider & Company, of 103 State Street, Chicago, have now brought out a new lighting appliance, which combines the flasher and a lamp receptacle into a single unit.

The flashing mechanism in the socket, Figs. 1 and 2, is the same as the regular "Firefly" only much reduced in size, and it operates equally as well as the larger instrument. The

FIG. 1.—FLASHER AND LAMP RECEPTACLE.

iridio-platinum contacts are of the same size as those used in the original flasher, and promise the same long, lasting qualities.

The flashing socket can be connected with the same facility as an ordinary socket, it being merely necessary to unscrew the insulating ring, lift off the cover, insert the wires through the porcelain base, fasten them to the binding screws and replace the cover and ring. When the lamp in the socket is turned on and the device warms up slightly it will begin to flash the light on and off automatically from 20 to 30 times a minute for a year or two. No readjusting is necessary. It works equally

FIG. 2.—FLASHER AND LAMP RECEPTACLE.

well with direct or alternating current, and about one-fourth less current is consumed than if the lamp were burning constantly.

Thermostatic flashers are now very extensively used to operate lamps in small electric signs, for attractive window-trimming effects, decorative lighting, Christmas-tree lamps and as an excellent display stand for holding tungsten or other new lamps to illustrate the light they give by shutting it off and on. In some forms of small signs made of all glass and metal, the flashing socket can be used without the ring and cover, as shown in Fig. 3. One illustration shows the flashing mechanism without the lamp and socket, and this will be known as the Midget "Firefly" flasher. It is to be connected in series to operate one or more lamps and it will cost less, but has not the capacity of the regular "Firefly" flasher.

The great majority of thermostatic flashers in use at the

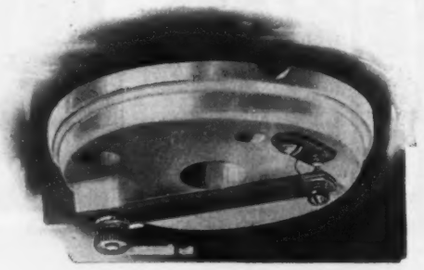


FIG. 3.—FLASHING MECHANISM.

present time are required to operate only a single lamp, and for this reason the new flashing socket should meet an already existing large demand. The advantages of a flashing socket over a separate flasher and socket seem evident, as the cost of the combined unit will about equal the cost of the regular standard flasher alone, and there is also the saving in time for wiring.

Anti-Vibration Device for D'Arsonval Galvanometers.

In many places, such as factories, shops and laboratories, where galvanometers are used, the shaking is so great that it produces vibrations of the coil that make an accurate scale reading impossible. These vibrations are of two classes: those about the vertical axis of the coil, and those about the horizontal axis. The first are quickly damped by the current itself, but the latter must be stopped mechanically. Up to this time the only satisfactory remedy for this trouble has been in the expensive Julius suspension, which is hung from the ceiling and supports the whole galvanometer.

The Leeds & Northrup Company, of Philadelphia, has recently developed a device consisting of a small light framework, weighing about 0.4 gram, which is fixed rigidly to the moving system of the galvanometer, by means of which it is claimed that the horizontal vibrations are quickly damped, and the scale is made distinctly readable, even under conditions of severe vibration.

As an adjunct to this device, to be used where the vibrations are unusually severe, there has been produced a new form of

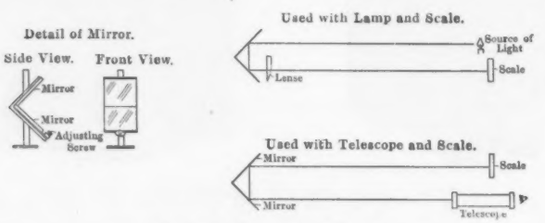


DIAGRAM OF ANTI-VIBRATION DEVICE.

reflecting mirror, as illustrated herewith. This mirror is said to eliminate to the eye any oscillations about the horizontal axis that the coil may take on. In fact, the system may be tilted backward and forward, or the arm and scale raised and lowered several inches, without disturbing the scale image in the telescope.

These anti-vibration devices may be attached to any galvanometer with a suspension of 4 in. or over, and are suitable for use with a telescope or a lamp and scale.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The vast improvement in the conditions of trade, which were chronicled for the week immediately succeeding the election, were continued during the second week. In almost every line there has been a steady increase in actual business, and the sentiment is more distinctly buoyant and brighter than it has been in a year. While there is no longer the feverish spirit of activity that was displayed within the first few days after the returns were known, there has been a steady expansion of business in every direction. Shipments over the railroads are rapidly increasing and the surplus of idle cars is disappearing. The number of idle men is diminishing every day, the industrial plants becoming busy entirely on the growth of orders. Collections are better than they have been for many months, and retail merchants all over the country are displaying more willingness to buy than they have at any time since the period of depression began more than a year ago. In this latter particular only the expected is occurring. It has been a well-known fact for months that stocks in the hands of retailers were badly broken and that only conservatism with regard to present commitments and uncertainty as to what the future might hold in store prevented liberal buying in the early autumn season. This policy of buying only for immediate needs has left the merchants in an exceptionally good condition financially and able to lay in any size stock the promises of the future may seem to demand. At the present time a large number of the orders are for immediate shipment. This not only on account of the depleted condition of stocks, but because many retailers have delayed purchases of holiday goods until the last moment. These, of course, are wanted at once. This class of buying and the fairly active business in spring lines have made busy the jobbers and wholesalers. The improvement is in evidence in practically every part of the country, although in some portions of the South where the planters are holding their cotton for better prices and some sections where drought has retarded industrial operations there is less being done than in the agricultural regions of the West and in the industrial centers of the coal States. The season's crops having been virtually all harvested, the only point of interest in this direction is the situation with regard to winter wheat. For the next crop the prospects are not so good. The acreage will probably be reduced and the crop will not be in a condition to stand the winter so well, owing to the prolonged dry weather in many sections. The culmination of this is, however, so far away that it is too early for any depressing news to be effective. As a reflection of the improved conditions, commodity prices have been steadily advancing. There is an advance in the demand for cereals for export and there have been heavy shipments of raw cotton and of oils. In textiles there has been an increased demand for cotton goods for spring delivery and there have been fairly heavy re-orders in men's wear woolens to fill out retail stocks that were only modestly taken. There has been increased activity in paper, leather, cotton, wool, iron and steel and in railway materials. In building there was a fine increase shown in October, although fuller returns are not so rosy as the preliminary estimates of the week previous. Reports from 80 show a net gain for the month of 19 per cent over September and are 11 per cent better than one year ago. The lumber mills continue to be exceptionally busy, and there is considerable being done in structural iron and steel. One market in which there has been exceptional activity and in which prices have been reached that are about the limit is that of crude rubber. The present quotations are almost double those of the low point during the past year. Orders for steel rails aggregate about 100,000 tons, some of the business being the replacement of old orders that had been held up pending the revival. These orders are placed at the old prices of $28 for Bessemer and $30 for open hearth. Cast-iron pipe is being ordered in moderate tonnage and other products of the iron industries are all showing the effects of revival. Business failures for the week ended Nov. 12, as reported by *Bradstreet's*, were 267, against 205 the week previous, 259 in like week of 1907, 222 in 1906, 198 in 1905 and 190 in 1904.

THE COPPER MARKET.

That there should have been some reaction in the copper market, succeeding the rush that occurred immediately after the election, was to have been expected. That the reaction in price has been so little and that the pressure to sell has been no greater is significant of the real strength of the market and the confidence with which the important interests in control of the situation maintain their position. It is apparent that the vast sales of metal which have occurred during the past few weeks have practically covered the demand for spot copper. Just at present the melters are more concerned with providing for January and future deliveries than in laying in further stocks of actual metal. These are not the trades that producers are especially seeking at present prices, and so the situation is such that buying is less active. The only pressure to sell that can be discerned is for spot copper, and the only eagerness to buy is for future delivery. It is estimated that during the past four weeks there has been sold in this market 150,000,000 lb. of copper for immediate delivery to both domestic consumers and for export. This, it is claimed by the producers and selling agencies, has about cleaned up the stocks of metal available for quick shipment. Possibly this is true, but from a close scrutiny of statistics it is difficult to understand why there is not a considerable surplus somewhere in the country. Production has been active during the months when consumption was light, and the production continues to increase even more rapidly than consumption. It is estimated that during October domestic consumption was about 40,000,000 lb., which is about 75 per cent of the normal melting in this country. For a month or two during the boom of 1906 consumption ran as high as 60,000,000 or possibly 70,000,000 lb., but the average for the year was only 56,000,000 lb. monthly, and normal melting in times of ordinary demand would probably be between 50,000,000 and 55,000,000 lb. per month. The total exports from all ports during last month were a little over 49,000,000 lb. Thus, if the copper shipped to foreign countries went into consumption—which is highly improbable—the total consumption in October was 89,000,000 lb. On the other hand, it is estimated that the output from domestic ores in October was about 90,000,000 lb. Imports are at the rate of about 18,000,000 lb. to 20,000,000 lb. monthly, so that we had a total supply in October of about 109,000,000 lb., against a consumption of 89,000,000 lb., showing an increase of about 19,000,000 lb. in surplus stocks, indicating that we are now carrying in this country about 175,000,000 lb. of copper. But these figures are mere statistics, which, while interesting and important, do not weigh much against a sold-up condition—which the producers assert exists at present. Add to this condition the bright promise of the future—with a dozen great railroads formulating plans for extensive electrification, with scores of hydro-electric plants under way and being planned in this country, and Europe proceeding with equal activity in this direction—and it is no wonder that prices of copper

Lake	14¼ @ 14½
Electrolytic	14⅜ @ 14¼
Castings	14 @ 14½

The London market was as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	62 17 6	63 5 0
Standard copper, futures	63 15 0	64 2 6
Market	Weak.	Firm.
Sales of spot		500 tons
Sales of futures		1,500 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Lake copper, spot	14½	12⅜
Electrolytic copper, spot	14⅜	12¼
Casting copper, spot	14¼	12⅛
London, spot	£64 17 6	£56 5 0
London, futures	65 15 0	56 17 6
London, best selected	68 10 0	60 0 0

can be maintained and that producers prefer waiting to making further concessions. Exports so far during November have not been unsually heavy, due, of course, to the advance in price and the demand at home. For the month, including Nov. 17, they were 10,968 tons. Prices quoted on the Metal Exchange on that date are given in the accompanying table.

ALLEGED SECRET SYNDICATE IN GERMAN ELECTRICAL INDUSTRY.—A number of the daily papers in Germany have recently published the text of an alleged agreement, arrangement or understanding said to exist among the large electrical companies of Germany according to which the companies arrange for the submission of high prices when they believe that they alone will be asked to bid, and that they agree as to which company should present the lowest offer in order to obtain the order. On the other hand, according to the statement, if the large companies are aware that other firms will be asked to compete, they tender at low prices or offer to the small firms a certain percentage on the estimated value of the contract, in order that the latter may abstain from the business, or fix a higher price than the projected cheapest offer. The protection agreement includes transactions of $5,000 and upward and the tendency of the agreement is claimed to be a fighting one and sharply turned against outsiders to whom no orders are to devolve. The reputed agreement, which appears to be divided into two sections, relates to what is termed protected business in regard to dynamos, motors, transformers, switchboards, etc., and in connection with which one firm is predetermined to receive the order, if possible, and the others support it against rivals. That such an agreement is in operation is said to be admitted by one of the firms concerned in a reply to the published account. According to the published statement, the Association of German Electricity Firms when organized in 1901 comprised the Allgemeine Company, the Bergmann Company, Brown, Boveri & Company, Essling Machine Works, Felten-Guilleaume & Lahmeyer, Garbe, Lahmeyer & Company of Aix-la-Chapelle, the Karlsruhe Electrical Industry Company, the Helios Company, Poege, Poschmann, the Schwartzkopff Company of Berlin, the Sachsen Works, Siemens-Schuckert, Max Schorch of Rheydt and the Cologne firm of Geist, which latter subsequently withdrew. A few years after the formation of the association, the suggestion was made among its constituents that endeavors should be made to establish a syndicate comprising all firms, as far as possible, for the improvement of prices. Negotiations on the subject were conducted in full meeting and in special committees for a long time; the draft statutes were repeatedly remodeled, and down to the present time the matter appears on many sides not yet to have been given up for lost, although in view of the variety of the products, the continual changes in the manufacture, the difference in sizes and the separate course of development of the individual producers, the question was and must remain an extraordinarily stubborn one. The endeavors to form a syndicate were again discontinued in 1903 on the ground that there was no prospect of bringing the scheme to a successful issue. It is alleged that the three firms—the Allgemeine Company, Felten-Guilleaume & Lahmeyer and the Siemens-Schuckert Company—then made an effort with the present so-called secret syndicate, that is to say, the protection agreement. The draft of the agreement is said to have been placed before all members of the Association of German Electricity Firms, and was discussed by them, and accession is still kept open on condition that those joining also agree to the fixing of a proportionate share in the total sales, such allotment to correspond at the highest to the last year's turnover of the new members. An understanding was, however, not obtained and finally all other firms were said to have remained outside the agreement. The contents of the agreement were, however, known to them and this, as well as the imperfections of the protection agreement, have materially weakened its effect. The agreement, according to the conception of those interested, aimed at the provision, in the first place, of a guarantee against the mutual and ruinous depression of prices. It was arranged that the three firms should not quote below certain minimum prices, and it was desired to render ineffective the system employed by customers of playing one firm against another. The alleged secret syndicate, it is said, has for years past really abstained from any aggressive action against outsiders. In general, the policy appears to be an endeavor to improve prices and not to fight. The idea that all orders competed for by the syndicated firms must fall to them is dismissed as utopian and unjust. The communication sets forth further that large municipal contracts and similar works are completely excluded from the agreement. Each of the firms is expressly empowered to accept and execute orders entrusted to it where the purchaser desires to give the order to it in preference to one of the other two firms at the price of the protected offer.

NEW INSTALLATIONS BY ALLIS-CHALMERS COMPANY.—Among the recent orders taken by the Allis-Chalmers Company are several from Wisconsin, where it is estimated that there is 2,000,000 hp of unused water powers. One of the most important of these is that of the Northern Hydro-Electric Company on the Peshtigo River. The initial installation will consist of five horizontal twin turbines, having each a capacity of 1500 hp, or an aggregate of 7500 hp, each directly connected to a 1000-kw alternating-current generator, with exciter units of 400-kw combined capacity, all the machinery being of Allis-Chalmers Company's build. This plant, which is near that of the Wausau Street Railway Company, now being equipped with hydro-electric units by Allis-Chalmers Company, will be second in industrial importance for the Head-of-the-Lakes country only to the Great Northern Power Company's immense development, where 40,000 hp in Allis-Chalmers turbines, the largest single Francis wheels in the world, are in operation. The current generated on the Peshtigo River will be transmitted to Green Bay and neighboring towns, to be used for the operation of the street railway system, commercial lighting and manufacturing purposes.

WIRE BUSINESS IMPROVING.—Since the election there has been a marked improvement in the wire business and the majority of the plants are busy. Referring to this, Mr. J. B. Olsen, of the Habirshaw Wire Company, had the following to say: "Our business is very much better at the present time than it has been at any time since the depressed times began, more than a year ago. While it is true that prices are as yet a trifle low—lower than they should be—orders and inquiries are coming forward in satisfactory volume. There are quite a number of inquiries for traction equipment and there seems to be a good lot of building that has been held up, but which will now be completed. The majority of the business that is now coming in is small, but there is enough of it to make a fair total. Our plant is operating at about normal at the present time. I think prices will go higher because raw material is constantly advancing."

I. P. FRINK LIGHTING SYSTEMS.—A number of contracts have been recently taken by I. P. Frink for lighting large buildings. The new National City Bank Building, New York, which was formerly the United States Custom House, is to be lighted by the Frink system, using the same novel features that have been installed in the Importers & Traders' Bank. Among other contracts is that of the Historical Society Building at Albany, where the system of lighting will be the same as that in use in the Metropolitan Museum of Art, New York. The Biological Society Building at Princeton, N. J., will also be illuminated by Frink reflectors, the main room being fitted with concealed lights. The Normal School Building at Albany is another large installation that this firm is now completing.

CROCKER-WHEELER HYDRO-ELECTRIC INSTALLATIONS.—The Crocker-Wheeler Company has recently received several orders for hydro-electric installations in the South. The Reedy River Power Company, at Ware Shoals, S. C., has ordered three 1500-kw generators with a complete outfit of switchboard and transformers. The transmission line will be 2200 volts and from 4000 hp to 5000 hp will be supplied to cotton mills at Laurens, S. C. Another installation in the same section is that of the Little River Power & Transmission Company, at Fayetteville, N. C. This embraces a 300-kw generator to be connected with a water turbine. The current is supplied to Manchester, N. C., for mills.

NAVY WIRELESS PLANT.—The Navy Department will shortly issue invitations for bids for the construction of a powerful long-distance wireless telegraph station. A mast is to be constructed in or near Washington 350 ft. to 400 ft. high, and it is expected to be able to get into touch with vessels 3000 miles distant. In the same advertisement bids will also be asked for two wireless ship equipments that will have a radius of 1000 miles. The new station will also be used for thoroughly testing the long-distance systems. If successful, the new high-power station may eventually supersede many of the stations now along the Atlantic Coast.

GENERAL ELECTRIC'S YEAR'S BUSINESS.—It is estimated that the report of the General Electric Company for its fiscal year, which ended Oct. 31, will show orders billed of about $40,000,000, or in the neighborhood of 60 per cent of the business done in the previous fiscal year. During the first three-quarters of the fiscal year the orders taken were $30,-054,924, against $49,677,500 in 1907, and it is estimated that the last quarter will run at about the same average. While the business of this concern as well as of the other big electrical manufacturing companies will increase as prosperity returns, the fact that many of the great installations that are now projected will be compelled to wait for new financing and the placing of bond issues may serve to retard any immediate boom.

ROTH BROS. COMPANY, CHICAGO, has contracted for a large building at the corner of Loomis and West Adams Streets and will move from the present quarters on Clinton Street to the new location early next year. The new quarters will allow the company to enlarge its line of electrical equipment and to otherwise broaden out. The New York office, which was opened several months ago, is proving an important factor in the company's increasing business.

Financial Intelligence.

THE WEEK IN WALL STREET.

The second week since the election has demonstrated the fact that the sudden boom in business was not altogether a flash in the pan but was simply the beginning of the continuous upbuilding of business that promises to last until all lines are upon a normal basis. The reason for this is, of course, that the result of the election has restored to the country the one necessary element to prosperity, and that is, confidence. All of the natural conditions have been favorable to liberal business and general prosperity for the past 10 months. Crops have been good, money very easy, and indebtedness among the producing class unusually small. In spite of all these trade has been stagnant, and the only reason that can be assigned is that the public was afraid of something unknown that might happen. In the stock market the tone continues to be as strong as it was a week ago, and there is a hopeful feeling on all sides that the reports of both industrials and railroads will soon begin to show the large volume of gross earnings that they did 18 months ago. Of course, after such an impressive and sudden advance as that immediately succeeding the election, it was but natural that there should be days of profit-taking when there were reactions recorded. Thousands of speculators and investors have found the profit which has accrued upon their holdings so alluring that they could not refrain from letting go. Many of them have relied on being able to get back when prices were somewhat depressed. In this hope a great many are likely to be disappointed, for the reactions have been but momentary and any renewed buying sentiment immediately sends prices upward again. One of the remarkable features of the market is its wonderful power for absorbing all of the shares that are offered. With daily transactions running well above the million-share mark there still seems to be more inclination to buy than to sell. This, of course, is because the public has at last taken hold and is contending with the insiders, who have so long been accumulating stocks, for the privilege of laying in supplies. Probably the most popular stock on the entire list, and certainly one in which the small investors have shown the most interest, has been United States Steel common. It is quite apparent that there is a belief widely entertained that as soon as business has been resumed in full swing the earnings of this company, which have been sufficient to accumulate a surplus even in the dullest of months, will be so great that an increase of dividend will become necessary. This buying sentiment in favor of steel has been in evidence since the price was below 30. The only news of any importance that has a disturbing tendency comes from those conferences in Washington where the revision of the tariff is being considered. The Republican party is pledged to this policy and as all manufacturers who have been heard in Washington seem to desire increased tariff rates it is a trifle confusing to calculate exactly what will be the program. Any tinkering with the tariff has an unsettling tendency, and this is the main reason for disturbance. Of course, there is some gossip to be heard in Wall Street to the effect that the big financial interests which are known to have accumulated long lines of low-priced shares last spring and during the summer, are at this time beginning to feed them out to the public at handsome profits. While this may be a proper theory of speculation, it is hardly borne out by the condition of the market. There seems to be no trouble about selling any stock that is offered and it is hard to believe that all of this buying is from the outside public. The best opinion is that the big financial backers of the bull movement are still prepared to take stocks and on any sort of a reaction would become active buyers. The bond market is little short of remarkable. For months the prices of good mortgage bonds, both industrials and railroads, have been steadily increasing and there seems to be no end to the demand for this kind of security. As an evidence of this the $20,000,000 worth of Illinois Central Railroad 4 per cent bonds which were offered by Kuhn, Loeb & Company last week were many times oversubscribed. On Nov. 16 the stock market was unsettled with unimportant changes. The money market shows some stiffening tendency, but not sufficient to cause any uneasiness or to create any difficulty in securing money for legitimate business purposes. During last week call money rates were up to 3 per cent, the highest point they have reached for months. The demand is somewhat better, but there still is apparently an enormous surplus in the banks. On Nov. 16 call money was quoted at 1½@2, and 90-day paper at 3¼@3½. The quotations in the table are those of the close Nov. 16.

NEW YORK.

	Nov. 9.	Nov. 17.	Shares sold.		Nov. 9.	Nov. 17.	Shares sold.
All.-Ch.	13⅞	13⅞	9,950	Int.-Met., pfd...	30⅞	36¼	28,975
All.-Ch., pfd....	46	47⅜	11,400	Mackay Cos. ..	76	77	2,400
Amal. Cop.	86¾	86¼	275,150	Mackay Cos.,pfd.	70¼*	70½*	400
Am. D. T.....	35*	35*	——	Manhattan Elev.	140	144	11,344
Am. Loc.	57¾	56⅛	25,060	Met. St. Ry....	24¼	33½	700
Am. Loc., pfd..	110½	110	1,025	N.Y. & N.J.Tel.	116	120*	520
Am. Tel. & Cble.	72½	75½	400	Steel, com.	54½	57½	1,182,666
Am. T. & T....	129¼	132	40,935	Steel, pfd.	112¾	113⅜	46,705
B. R. T.....	52½	56¼	88,880	W. U. T.....	63¼	65	8,170
Gen. Elec.....	154	155	11,310	West'h., com. ..	91¼	92	14,900
Int.-Met., com..	10⅝	13⅞	38,980	West'h., pfd....	120	120	600

PHILADELPHIA.

	Nov. 9.	Nov. 17.	Shares sold.		Nov. 9.	Nov. 17.	Shares sold.
Am. Rys.	45	46	——	Phila. Elec.	12¼	12⅛	——
Elec. Co. of A..	10	10⅞	——	Phila. R. T....	20¾	21⅞	——
Elec. Stor. B'ty.	40	41	——	Phila. Traction.	89	89*	——
E. S. B'ty, pfd.	49*	49*	——	Union Traction.	50	50	——

CHICAGO.

	Nov. 9.	Nov. 17.	Shares sold.		Nov. 9.	Nov. 17.	Shares sold.
Chi. City Ry...	176*	176*	——	Chi. Tel. Co....	125½	127	——
Chi. Rys., Ser.1.	110	110*	——	Met. El., com...	13	13*	——
Chi. Rys., Ser.2.	46¼	46¼	——	Nat'nal Carbon.	69*	83	——
Com. Edison...	110	108¼	——	Nat. Carb., pfd.	110¼	110¼	——
Chi. Subway...	23½	23⅓	——				

BOSTON.

	Nov. 9.	Nov. 17.	Shares sold.		Nov. 9.	Nov. 17.	Shares sold.
Am. Tel. & Tel.	129½	132½	——	Mass. E. R.,pfd.	55½	56¾	——
Com'bind Tel...	122*	122*	——	Mex. Tel.	—	3	——
Gen. Elec.	154	156	——	Mex. Tel., pfd..	5¼	5½*	——
Edison El. Ill...	247½	247½	——	N. E. Tel'p....	125	126	——
Mass. Elec. Ry.	10½	12	——	W. Tel. & Tel..	7¾	9½	——
				W. T. & T., pfd.	78½	78½*	——

*Last price quoted.
Shares sold are for week Nov. 9 to Nov. 14.

DIVIDENDS.

Grand Rapids (Mich.) Railway Company, common, quarterly, 1 per cent, payable Dec. 1.

American Railways Company, Philadelphia, Pa., quarterly, 1½ per cent, payable Dec. 15.

Georgia Railway & Electric Company, Atlanta, Ga., quarterly, 1½ per cent, payable Nov. 20.

Michigan State Telephone Company, Detroit, Mich., common, quarterly, 1 per cent, payable Dec. 1.

Michigan State Telephone Company, preferred, quarterly, 1½ per cent, payable Feb. 1, 1909.

Kings County Electric Light & Power Company, Brooklyn, N. Y., quarterly, 2 per cent, payable Dec. 1.

Philadelphia (Pa.) Electric Company, semi-annual, 3 per cent, payable Dec. 15.

PROPOSAL TO RATIFY WESTINGHOUSE READJUSTMENT PLAN.—A special meeting of stockholders of the Westinghouse Electric & Manufacturing Company has been called for Nov. 24, 1908, to take action upon the following matters: 1. The increase in number and the classification of the board of directors, in accordance with the Act of the Assembly of the Commonwealth of Pennsylvania, approved June 17, 1887. 2. The adoption of new by-laws or the amendment of the present by-laws of the company in such respects as may be

deemed necessary to carry into effect the "modified or substitute plan for the readjustment of debt" of the company, heretofore adopted by the board of directors, and in such other respects as may be deemed advisable. 3. The election of a board of directors. 4. The election of a proxy committee. 5. The consideration of the "modified or substitute plan for the readjustment of debt" of the company, which has been adopted by the board of directors, and the adoption of such resolutions as may be necessary to carry said plan into effect. The special meeting of stockholders of the company, heretofore called for April 29, 1908, to take action upon an increase of the capital stock of the company, and adjourned from time to time, will also be held at the office of the company at East Pittsburg on the same date. A circular addressed to the stockholders on Nov. 11 by Charles A. Terry, secretary of the company, says in part:

"The modified plan for the readjustment of the debt of the company will require approximately $14,200,000 of new assenting stock of the company, to be issued to holders of the merchandise debt and bank debt and to stockholders who have subscribed for new stock in cash. Of the present authorized assenting stock of the company $12,500,000 is reserved against the convertible gold bonds of the company, and $23,940,000 is issued, leaving only $9,560,000 unissued. It is therefore necessary to increase the authorized capital of the company, and at that meeting of stockholders it is proposed to authorize $10,000,000 of additional stock, the increased stock to have all the rights, priorities and privileges of the present assenting stock of the company.

"The arrangements finally approved by the various committees involve the election of a board of 16 directors, which is to be classified into four classes of four members each, the term of the first class expiring at the date of the next annual meeting of the company, July 28, 1909, and that of the other classes in one, two and three years from that date respectively.

"It is also proposed, in compliance with the plan, to constitute a proxy committee to remain in existence for five years.

"The necessary amendments to the by-laws to effectuate these requirements of the plan, and also other amendments dealing with the future management and direction of the operations of the company will be placed before the stockholders for adoption at the meeting, at which, or an adjournment thereof, the new board of directors and a proxy committee will be elected."

AMERICAN BELL TELEPHONE REPORT FOR SEPTEMBER.—The report of the associated Bell telephone operating companies, not including the long-distance lines of the American Telephone & Telegraph Company, for September, 1908, shows as follows as compared with September, 1907: Telephone revenue, September, 1908, $10,114,700 as against $9,639,100 for September, 1907; operating and maintenance expenses for September, 1908, $7,222,100 as compared with $6,893,700 for September, 1907; net earnings from operation for September, 1908, $2,892,600 as compared with $2,745,400 for September, 1907; sundry earnings for September, 1908, $450,300 as against $376,600 for September, 1907; total net earnings for September, 1908, $3,342,900 as against $3,122,000 for September, 1907; interest for September, 1908, $622,700 as against $634,400 for September, 1907; balance for dividends for September, 1908, $2,720,200 as against $2,487,600 for September, 1907.

MINNESOTA & ONTARIO POWER COMPANY, MINNEAPOLIS, MINN.—Peabody, Houghteling & Company, Chicago, offer at par and interest $3,000,000 first mortgage 6 per cent serial gold bonds of the Minnesota & Ontario Power Company. The bonds are guaranteed by the Backus-Brooks Company, Minneapolis, a large stockholder of the Minnesota & Ontario Power Company. The power company was organized under the laws of Maine in September, 1908, to develop the water-power on both sides of the Rainy River at International Falls, Minn., and Ft. Frances, Ontario, and is said to have expended more than $1,250,000 in securing water grants and in construction.

EDISON ELECTRIC ILLUMINATING COMPANY, BOSTON, HAS 3000 STOCKHOLDERS.—Some interesting facts have been made public recently regarding the holdings of stock of this company. The largest stockholder is the estate of Susan B. Cabot, with 2052 shares, valued at the present market price (247½) at $755,370. J. P. Morgan was at one time the largest stockholder, but he has disposed of his 3410 shares during the past six months. The average holding in the company is 42 shares. There are 24 stockholders who own more than 500 shares each. Their aggregate holdings are 20,517 shares, or 16 per cent of the total number of shares outstanding.

PHILADELPHIA ELECTRIC DIVIDEND INCREASED.—This company has increased its dividend 1 per cent per annum, putting the stock on a 6 per cent basis.

EARNINGS OF COMPANIES.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
American Railways, Philadelphia:					
October, 1908	$230,984	.....	.....	.....	.....
October, 1907	242,299	.....	.....	.....	.....
International Railway, Buffalo, N. Y.:					
September, 1908	1,355,952	$798,102	$557,850	$224,768	$333,082
September, 1907	1,487,799	866,081	621,718	206,329	415,389
Electrical Securities Corporation, New York:					
Year ended Oct. 31, 1908	349,014	208,195	144,920	.....	611,211
Year ended Oct. 31, 1907	361,185	193,414	254,833	.....	918,886
Buffalo (N. Y.) Crosstown Street Railway:					
Three months ended Sept. 30, 1908	167,933	101,759	66,174	37,175	28,995
Three months ended Sept. 30, 1907	187,484	112,221	75,263	37,175	38,088
†Associated Bell Telephone Operating Companies, New York:					
September, 1908	10,565,000	7,222,100	3,342,900	622,700	2,720,200
September, 1907	10,015,700	6,893,700	3,122,000	634,400	2,487,600
Charleston (S. C.) Consolidated Railway, Gas & Electric Company:					
October, 1908	60,655	41,693	18,961	15,074	3,887
October, 1907	58,551	39,872	18,679	14,942	3,738
Fort Wayne (Ind.) & Wabash Valley Traction Company:					
September, 1908	122,443	60,973	61,469	.....	.....
September, 1907	125,732	69,984	55,748	.....	.....
Lexington (Ky.) & Interurban Railways:					
September, 1908	64,049	36,670	27,378	.....	.....
September, 1907	59,195	31,120	28,076	.....	.....
Norfolk (Va.) & Portsmouth Traction Company:					
September, 1908	162,938	94,834	68,104	.....	.....
September, 1907	*295,611	161,921	133,690	.....	.....
Fairmount (W. Va.) & Clarksburg Traction Company:					
September, 1908	41,934	12,470	27,272	1,927	27,537
September, 1907	37,328	14,316	21,544	947	22,065

†Not including long-distance lines of the American Telephone & Telegraph Company.
*Year of Jamestown Exposition.

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—The Birmingham & Shades Mountain Electric Railway Company is reported to have been organized to build an electric railway which will enter the Shades Valley and extend to the top of Shades Mountain. R. A. Berry, of Birmingham is reported to be interested in the enterprise.

BIRMINGHAM, ALA.—It is reported that the Yolande Coal & Coke Company, which recently purchased 100 acres of coal lands in North Birmingham, is preparing plans to construct a large power plant in connection with its coke ovens, and proposes to furnish electricity in North Birmingham and adjacent cities.

MARION, ALA.—Arrangements are being made to extend the telephone service of Marion to both the eastern and western portions of the county. A direct line will be erected from Radford to Marion. It is also stated that a telephone line will be built via Curbdale, Heiberger and Jericho to Centerville.

MONTGOMERY, ALA.—C. E. White, who recently purchased the ice and power plant and franchises of the estate of D. P. West, will make improvements to the plants, the cost of which is estimated at $30,000. It is proposed to organize a company to operate the property. C. E. White is treasurer and general manager.

MESA, ARIZ.—The Mesa Electric Light & Power Company is building a new substation. The cost of the work is estimated at $2,000.

FAYETTEVILLE, ARK.—Application has been made by Louis Moulton, of Boston, for a franchise to construct and operate a street railway system to connect with a proposed electric railway from Siloam Springs to Huntsville, Ark.

FAYETTEVILLE, ARK.—G. T. Propper, of Minneapolis, Minn., is reported to be interested in a project to build a belt line connecting with a railway to Joplin, Mo., using an old right of way granted for a steam road from Fayetteville, east six miles.

LITTLE ROCK, ARK.—The Little Rock & Hot Springs Electric Railway Company has filed amendments to its charter, increasing the capital stock of the company by $500,000. The company proposes to construct an electric railway from Little Rock to Hot Springs, a distance of 56 miles.

POCAHONTAS, ARK.—The Ozark telephone system at Pocahontas has been leased by G. A. Dorris, who will operate it in connection with the Corning telephone system.

BAKERSFIELD, CAL.—Edwin Alderson has applied to the Board of Supervisors of Kern County for a franchise to erect transmission lines for the purpose of transmitting and distributing electricity on certain roads in the county. Bids for the above franchise will be received until Dec. 5 by I. L. Hiller, clerk of the board.

BERKELEY, CAL.—The City Trustees are considering a proposition submitted by the Southern Pacific Railroad Company for permission to change the equipment of its railroad to be operated by electricity and for additional franchises, which if granted will give the Southern Pacific Company five additional lines extending from the southern to the northern boundaries of Berkeley. The company has also announced its intention of extending its present lines into Contra Costa County. The work contemplated will involve an expenditure of about $2,000,000. W. B. Scott is general manager.

COLUSA, CAL.—C. K. Sweet has applied to the Board of County Supervisors for a franchise to erect additional transmission lines to transmit electricity for lamps and motors throughout Colusa, bids for which will be received until Dec. 8 by W. J. King, clerk of the board.

FRESNO, CAL.—The City Trustees have granted a franchise to F. S. Granger for the proposed Fresno-Hanford interurban railway.

FRESNO, CAL.—Arrangements are being made by the owners of the Fresno copper mine to change the motive power of its plant from steam to electricity. The San Joaquin Light & Power Company, of Fresno, will furnish electrical energy to operate the plant.

GREENVILEE, CAL.—Arrangements are being made by small farmers in Plumas County to irrigate their land with water pumped by electricity which will be furnished by the Round Valley Land & Power Company. The company is constructing a plant west of Greenville, where a fall of 900 ft. can be secured and about 2000 hp developed. The company will also furnish electrical energy to light the towns in this vicinity. Charles K. Reid is interested in the enterprise.

MANTON, CAL.—R. L. Swanson, manager of the Manton and other telephone systems, has secured the contract to extend the telephone line on the Cone ranch to Ellenwood sheep camp, a distance of about 20 miles. The line will be a metallic circuit throughout.

OAKLAND, CAL.—Plans are being prepared by the Pacific States Telegraph & Telephone Company for extensive improvements in Brooklyn Township, which will involve an expenditure of about $80,000.

OROVILLE, CAL.—Surveys are now being made up the Similkameen River for the purpose of locating a site for a dam to furnish power to generate electricity. It is reported that the company behind the project proposes to construct an electric railway down the Okanogan Valley.

PASADENA, CAL.—It is reported that arrangements are being made to file articles of incorporation for the Pasadena Rapid Transit Company, which will be capitalized at $3,000,000. The promoters propose to construct a railway between Los Angeles and Pasadena, a distance of about 93 miles. Horace M. Bobbins is said to be interested in the enterprise.

REDWOOD CITY, CAL.—The Board of Supervisors has decided to extend the lighting system into Wellesley and Dingee Parks and the main line along the Whipple Road, for which the clerk has been directed to ask for bids for material.

SACRAMENTO, CAL.—Bids will be received until Nov. 30 by M. J. Desmond, city clerk, for lighting the streets and public departments of the city of Sacramento for one year from Dec. 31.

SACRAMENTO, CAL.—An agreement has been made between the Great Western Power Company and the committee of the Board of Trustees whereby the Great Western Power Company will be granted a franchise to erect its system in the city. By the terms of the agreement the company is to furnish at least 7500 hp to consumers in Sacramento, to place its wires underground in certain sections of the city and to allow the city to use its poles for the fire alarm system, and after five years to pay the city 2 per cent of the gross earnings of the company. Machinery has already been ordered for the Brighton substation, the cost of which, including the building, is estimated at $156,000. Machinery for the city plant will be ordered in the near future.

SAN BERNARDINO, CAL.—H. W. Hagerman, of San Bernardino, Cal., and J. R. Jordan, of Canada, have been granted a franchise to install an electric light and power system covering a territory three miles square. They will erect eight miles of transmission lines at once.

SAN FRANCISCO, CAL.—The water-power properties on the American and Cosumnes Rivers, owned by W. H. Tevis, which were recently offered to the city for a municipal water supply, are to be developed for the production of electric power.

ST. HELENA, CAL.—E. D. N. Lehe, of Dixon, who is constructing a transmission line between Napa and Calistoga, has notified the Town Trustees that he will be prepared to furnish electricity in St. Helena during the coming winter, and will probably consolidate with the local lighting company. Electricity for operating the system will be purchased from the Bay Counties Power Company.

COLORADO SPRINGS, COL.—George L. Bullock, of New York, N. Y., has purchased the control of the Empire Water Company of George A. Taff for $100,000. Following the purchase of the stock of the Empire Water Company it was given out that about $500,000 would be spent by Mr. Bullock and his associates in improving the pipe lines, the construction of a new power-house and extensions of the system. Mr. Bullock is interested in other electric companies of the Pike's Peak region. The Empire Water Company is capitalized at $1,000,000.

DANBURY, CONN.—An electric light plant is to be installed in the Hotel Green to furnish electricity for lamps, refrigerating and other purposes. The equipment of the plant includes two engines and generators, one of 15 and the other 25 hp, contract for which has been awarded to the Fairbanks, Morse Company, of New York, N. Y.

MANCHESTER, CONN.—The Board of Selectmen passed a resolution on Nov. 5 to inform the Glastonbury Power Company that the town from that date will only pay half of the amount agreed upon for street lamps, until such time as the service is made satisfactory. The town now pays at the rate of $10 per year for each incandescent lamp.

WINDHAM, CONN.—It is reported that the Smith & Winchester Company has awarded the contract for the installation of the electrical work in its new factory, now under construction, to the Coghlin Electric Company, of Worcester, Mass., for $10,000.

WASHINGTON, D. C.—The contract for furnishing electric lamps for the U. S. Capitol has been awarded by the superintendent of the U. S. Capitol to the General Electric Company, Schenectady, N. Y., for $5,725.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of District of Columbia, Washington, D. C., until Nov. 30 for furnishing the District Government with switchboards, conduits and cables for use in the McKinley Manual Training School. Specifications, blank forms of proposal and necessary information may be obtained at the office of the property clerk, District of Columbia, District Building, Washington, D. C. D. C. Henry, B. F. MacFarland, Henry L. West, Jay J. Morrow are commissioners.

PABLO BEACH, FLA.—The Pablo Beach Development & Power Company is reported to have purchased most of the property of the East Coast Railway Company at Pablo Beach. The company plans to make extensive improvements, including the construction of an electric light plant and water works system.

SEABREEZE, FLA.—Applications have been made to the City Councils of Seabreeze and Daytona Beach by S. H. Gove for franchises to operate an electric trackless trolley system.

TAMPA, FLA.—Bids will be received until Nov. 27 for lighting the streets of the city with about 100 arc lamps. W. Lesley Brown is acting mayor.

AUGUSTA, GA.—It is reported that work has commenced on the survey for the proposed plant of the Twin City Power Company, under the direction of Nisbet Wingfield, of Augusta. The cost of the proposed plant, including dam, power-house, transmission lines, substations, etc., will be about $3,500,000, the contract for which, it is stated, has been awarded to the Ambursen Hydraulic Construction Company, of Boston, Mass. The dam will be located at Price's Island on Savannah River, about 20 miles above the city. The plant will furnish electricity for lamps and motors in Augusta. The Twin City Power Company has purchased a site for the substation, which will be located in North Augusta.

THOMASVILLE, GA.—Extensive improvements to the municipal electric light plant are recommended by D. R. Pringle, superintendent of electrical apparatus, including the installation of two direct connected units, to cost $10,000 each; also a boiler to cost about $1,000.

CŒUR D'ALENE, IDAHO.—The Slate Creek Electric Power & Light Company has applied to the City Council for a 50-year franchise in the city. The company proposes to erect an electric plant and furnish electricity for lamps and motors in Cœur d'Alene to compete with the Wallace Light & Power Company. The company is capitalized at $3,000,000. D. L. Hopkins, Thomas McGowan, Jesse Freeman and William Sites are interested in the company.

MACKAY, IDAHO.—Plans are being made by the Lost River Light & Power Company for the construction of an electric light plant at Mackay, power for which will be developed on Cedar Creek.

ARCOLA, ILL.—The Arcola Grain, Coal & Telephone Company has increased its capital stock from $8,000 to $11,000.

CHANDLERVILLE, ILL.—Bonds to the amount of $7,100 have been sold, the proceeds to be used for the construction of an electric light plant. It is reported that Roy Ray will have charge of the installation of the plant.

CHICAGO, ILL.—The Commonwealth Edison Company has leased three acres adjoining its present holdings on the Chicago River, at Quincy Street, and will enlarge its plant.

EUREKA, ILL.—The Council has granted the Roanoke Mutual Telephone Company a franchise to place its telephone wires in underground conduits.

HARRISBURG, ILL.—The City Council has granted a 50-year franchise to the Saline County Traction Company, of Danville, Ill., to operate an electric railway in Harrisburg and to connect with adjacent cities.

KANSAS, ILL.—E. G. Rose, city clerk, writes that the sale of the municipal electric light plant to S. J. Blatchford last June was not consummated, owing to the failure of the purchaser to meet the requirements of the sale. The plant is now operated by the municipality and is still for sale. Sherman Hough is chief electrician.

MORTON, ILL.—The Farmers' Mutual Telephone Company has been granted a franchise to establish a telephone system.

PEORIA, ILL.—The Peoria Foundry Company has awarded a contract for the construction of its new foundry and elevator, and is in the market for motors, cranes, foundry supplies, etc.

SILVIS, ILL.—The United Light & Power Company has commenced work on the construction of a power plant which will furnish electricity for lamps and motors in Silvis and East Moline, Ill. The company is in the market for the following second-hand machinery: One 100 to 150 kw alternating-current, three-phase generator, boiler and engine; 40 alternating-current, series enclosed arc lamps; two 25 light regulators, switchboards, etc.

TAYLORVILLE, ILL.—The Christian County Telephone Company has purchased all the local telephone exchanges of the Central Union Telephone Company in Christian County for a consideration of $25,000.

TREMONT, ILL.—The citizens have voted to purchase the local electric light plant. The company has accepted the offer of the village to pay $5,500 for the plant and the village to assume the $6,500 mortgage held by Frank O'Meare, of St. Paul, Minn. It is proposed later to build a water-works system in connection with the electric light plant.

AURORA, IND.—The Aurora Electric Company has increased its capital stock, the proceeds from which are to be used in widening and increasing the company's business. David J. Haus is president and Charles F. Mayer, secretary.

EVANSVILLE, IND.—Plans are being made by the Evansville Gas & Electric Light Company for extensive additions to its electric and gas systems, which will involve an expenditure of about $400,000 and will include the installation of a turbo-generator set at the electric plant at Main and Division Streets. A new gas holder will be built and extensions will be made to the gas mains in the city.

FRANKFORT, IND.—The municipal electric light plant was badly damaged by the bursting of a heavy engine flywheel Oct. 27. The City Council purchased immediately a 500-kw steam turbo-generator set from the Allis-Chalmers Company, Milwaukee, Wis., which is now being installed. To guard against future interruption of service, the City Council has decided to install a duplicate unit. Bids have been asked for one 300-kw, two-phase, 60-cycle turbo-generator set; one 75-hp, two-phase, induction motor, and condensers for one 500-kw and one 300-kw unit.

MARION, IND.—Edgar R. Vincent, of Indianapolis, Ind., is reported to have been appointed to have charge of selecting and installation of the machinery for the new municipal electric plant.

TERRE HAUTE, IND.—The officials of the Pleasant Shades Power Company, recently incorporated with a capital of $100,000, have opened offices in this city. M. H. Ewers, president of the company, states that a hydro-electric plant and summer resort will be constructed and equipped on Sugar Creek, near Waveland. The plans provide for a dam 300 ft. long and 20 ft. high. A 500-kw electric power plant will be installed.

DES MOINES, IA.—The Mutual Telephone Company has purchased the plant and holdings of the Hawkeye Telephone Company. The price paid for the system is said to be $350,000. The system includes 500 miles of toll lines and 1100 miles of rural telephone lines and exchanges at Perry, Valley Junction, Indianola, Winterset, Guthrie Center, Panora, Greenfield, Stuart and Adel.

IOWA CITY, IA.—The Johnson County Telephone Company has been reorganized and contemplates extensive improvements, which will involve an expenditure of about $35,000. Jay Chatham is secretary and treasurer.

LE MARS, IA.—The Plymouth County Telephone Company is erecting new telephone lines in Marion Township and will extend its lines to Grant and Washington Townships.

MALVERN, IA.—Arrangements have been made by L. W. Boehner, of the Malvern Electric Light & Power Company, with the city of Tabor whereby he is to furnish electricity to light the city, for which the citizens have voted to grant the company a franchise. Business men of Tabor have taken $7,500 of the capital stock in the reorganized company.

FORT RILEY, KAN.—Bids will be received by Captain W. M. Whitman, constructing quartermaster, until Nov. 25 for the construction of approximately 750 ft. electric conduit and installation of cable, etc.

LAWRENCE, KAN.—The City Council has granted a franchise to the Kansas City-Lawrence-Topeka Electric Railway Company. W. R. Stubbs, A. Henley and C. E. Sutton are interested in the enterprise.

LEAVENWORTH, KAN.—Announcement has been made by Mayor Crancer that the telegraph, telephone and electric light companies will be compelled to comply with the ordinance requiring all wires within a certain district, including the business section of the city, to be placed in underground conduits.

OTTAWA, KAN.—The Water and Light Board are making arrangements to enlarge the municipal electric light and water works plant, plans for which are being drawn by Washburn & Son. It is proposed to enlarge the power house and move the old Corliss engine from the old power plant. The secretary of the board was directed to secure prices on new and second-hand 100-kw generators.

ST. MARYS, KAN.—Contracts for the construction of the water works system have been awarded to N. W. Cook & Son, of Junction City, Kan., as follows: General construction, $22,760; tower and tank, $3,100; hydrants and valves, $1,400; pumping machinery, $1,500, and high-speed engine, $1,300. All bids for electric equipment, including generator, switchboard and lighting system for the city lighting plant, have been rejected. New bids will be received until Nov. 20 for the above equipment, including electrical meters. Burns & McDonald, of Kansas City, Mo., are the engineers.

WICHITA, KAN.—The Dodd Packing Company has entered into a contract with the Edison Electric Company to supply electricity to operate its plant. The contract includes the erection of a substation at the packing house. The cost of the improvements is estimated at $50,000. The substation will be located just inside of the Dodd property and will supplant the electrical plant of the packing company, the equipment of which includes five dynamos and 60 motors. A. H. Almert is manager of the Edison Electric Company.

FRANKFORT, KY.—Bids have been called for the electric lighting fixtures for the State Capitol, for which $25,000 has been appropriated.

HINDMAN, KY.—The Knott County Telephone Company is making arrangements to erect a local independent line from Vest to Republican, a distance of 13 miles.

PIKEVILLE, KY.—The Eastern Kentucky Home Telephone Company, which has built a telephone line from Pikeville to Baker, announces that it will commence work at once on the construction of a line from Vergie, via Beatrice, to Dorton, a distance of about 15 miles. N. Starkey is manager.

ALEXANDRIA, LA.—The Board of Aldermen has granted the Alexandria Electric Street Railway Company permission to construct a railway out Levin Street to the Kent property, provided the company maintains its lines on South Lee and Vance Avenues. C. M. Waters is president.

BATON ROUGE, LA.—The Cumberland Telegraph & Telephone Company is contemplating extensive additions to its telephone system throughout the State of Louisiana. It is proposed to extend the telephone line from Baton Rouge to Lake Providence. An extension from Baton Rouge to New Roads is now under way. Plans are also being made to erect a line from Alexandria to Monroe, work on which will begin in the near future.

WAVERLY, LA.—G. W. Clark, of Waverly, has been awarded the contract for the construction of the power house for the electric light and power plant and water works system for $10,400.

MT. WASHINGTON, MD.—The Mt. Washington Electric & Power Company is contemplating extending its transmission line from Lutherville to Cockeysville.

FALL RIVER, MASS.—The American Printing Company is increasing the electrical equipment of the plant, including the installation of a three-wire, 250-125-volt, 500-kw generator driven by a 1000-hp engine.

MANCHESTER, MASS.—The Manchester Electric Company has disposed of its electric plant and franchise to the Boston & Northern Street Railway Company. The transfer for the present is in the nature of a one-year lease, with the option of purchase at the end of that time. The present board of directors will hold over for another year until a final disposition is made of the plant.

GRAND RAPIDS, MICH.—Bids will be received by the Board of Public Works until Nov. 27 for sewage pumping machinery consisting of four 40-in., four 24-in. and two 18-in. centrifugal pumps, four 175-hp, two 75-hp, two 60-hp and three 30-hp electric motors, vacuum pumps, piping, etc.

HARRISON, MICH.—The Harrison Heading Company is in the market for a second-hand 60-kw, 250-volt, direct-current generator and engine direct connected or separate.

IRONWOOD, MICH.—Extensive improvements are contemplated by the Twin City General Electric Company to its system in Ironwood, which will include the installation of additional machinery in the electric light plant and extensive improvements to the water works and street railway systems.

KALAMAZOO, MICH.—The Michigan State Telephone Company, it is reported, will expend $100,000 in extending its underground conduit system in this city. About five miles of conduit will be laid.

BAGLEY, MINN.—The Bagley-Omega Telephone Company contemplates extending its line from Convick and other points in Clearwater County.

CLARISSA, MINN.—Plans are being considered to extend the rural telephone line No. 7 several miles to the southeast.

BAY ST. LOUIS, MISS.—Plans are being made for the construction of an electric street railway connecting the Jourdan River and Bay St. Louis, Miss., and other places on the Gulf Coast. The cost of the road is estimated at $1,500,000.

COLDWATER, MISS.—At an election held Nov. 10 the citizens voted against the propositon to issue bonds for the construction of an electric light plant and water-works system.

NATCHEZ, MISS.—The Cumberland Telephone & Telegraph Company is planning to erect a telephone line from Natchez to Washington, Miss., a distance of about seven miles. D. W. Lacy is general manager of the company.

NEW ALBANY, MISS.—Bonds to the amount of $10,000 have been issued by the city, the proceeds to be used to purchase additional machinery for the municipal electric light plant. G. S. Mitchell is city clerk.

COLUMBIA, MO.—O. W. Sprate, of St. Louis, Mo., and V. M. Dissaffrey, of Buffalo, N. Y., are interested in a project to build an electric railway to connect Columbia and Mexico.

MONETT, MO.—The Monett Electric Light, Power & Ice Company has decided to establish a day service, which will involve an expenditure of about $7,000 to put the plant in order to furnish the service. C. W. Copeland is superintendent.

BUTTE, MONT.—Announcement has been made by John D. Ryan, who with associates purchased the Great Falls Power & Townsite Company, that work will commence on the construction of the dams, power plant and the erection of a transmission line 165 miles long. The plant when completed will furnish electrical energy to operate the Butte mines. The company also will erect a wire factory at Great Falls, also a plate glass, carbide and cement factory, to be operated in connection with the power plant. The cost of the work is estimated at $5,000,000.

MISSOULA, MONT.—Plans are being made by the Missoula Light & Power Company to increase the output of its plant to provide electricity for 1000 additional lamps.

OAKLAND, NEB.—The New State Telephone Company has applied for a franchise to install a telephone system in Oakland.

RENO, NEV.—It is reported that W. P. Hammon, of San Francisco, Cal., has acquired control of the Truckee River General Electric Company. The property consists of two large power plants on the Truckee River and a large distributing system, transmitting electricity to Reno, Carson, Virginia City, the copper mining district at Yerington and other sections of Nevada. It is said that Mr. Hammon intends to enlarge the plants and build branches throughout the mining districts in Nevada, which will involve an expenditure of about $1,000,000. Orders have been given for extension of the Reno street car lines to cover the entire city.

MANCHESTER, N. H.—The State Railroad Commissioners have granted the petition of the Manchester Traction, Light & Power Company to increase its capital stock by $400,000, the proceeds to be used to take over the stock of the Manchester & Nashua and the Manchester & Derry Street Railway Companies, and also $275,000 of the stock of Manchester Street Railway Company previously authorized, but not issued, which will leave a balance of $35,000, which will be used for improvements. The Commissioners also granted the petition of the Manchester & Nashua Street Railway Company for an increase of $40,000 in capital, and the Manchester & Derry Street Railway Company to increase its capital stock by $50,000.

BALDWINSVILLE, N. Y.—The plant and property of the Baldwinsville Telephone Company has been purchased by the Onondaga Independent Telephone Company. Arrangements are being made by the new owners to remodel and extend the plant, which will include the reconstruction of the exchange and lines. Bonds to the amount of $11,500 have been issued to pay for the work.

CANTON, N. Y.—The Hannawa Power Company is now furnishing electricity for operating the system of the Canton Light & Power Company. The local company has completed its new substation and will abandon the old power plant on Water Street, and the equipment will be sold. The Canton company is now prepared to furnish electrical energy for lamps, heat and motors.

COPENHAGEN, N. Y.—The Village Board has granted a franchise to Stephen B. Cleveland, of Watertown, N. Y., to install an electric light plant. Mr. Cleveland is endeavoring to secure a contract from the village for street lighting, and if a sufficient number of lamps for commercial and residential lighting is secured, work will commence on the construction of the plant. For the present the plant will be operated by steam power, but later it is expected that the water power recently acquired at High Falls by Mr. Cleveland will be utilized.

DANVILLE, N. Y.—The Danville Electric Company has decided to erect an electric light plant in Danville at once. C. T. Meadows is manager.

FULTONVILLE, N. Y.—The Board of Village Trustees has entered into a contract for a term of one year with the Cayadutta Generating Company, of Fonda, N. Y., for lighting the village streets with electricity.

NATURAL DAM, N. Y.—It is understood that after Jan. 1, 1909, the Aldrich Paper Company, of Natural Dam, N. Y., will close the pulp mill it is now operating at Emeryville, N. Y., and convert the plant into a hydro-electric generating station, with transmission line extending to Natural Dam, where the energy will be utilized in connection with paper mill now under operation.

NEW YORK, N. Y.—The contract for the interior conduit and wiring system for vacuum tube lighting on the first floor of the New York court house has been awarded to McLeod, Ward & Company, of New York, N. Y., for $3,795.

PHELPS, N. Y.—The Board of Village Trustees have granted the Phelps Home Telephone Company a new telephone franchise, in return for which the telephone company agrees to rebuild and enlarge the telephone system and to install a telephone fire alarm system.

WINSTON-SALEM, N. C.—Arrangements are being made by George H. Hauser and others to construct a telephone line from Winston-Salem to Wilkesboro, N. C. A telephone line is now being constructed from Winston-Salem to Madison, where it will connect with the Rockingham Telephone Company.

BEACH, N. D.—The Golden Valley Telephone Company is making arrangements to install a telephone system in Beach.

INKSTER, N. D.—The Parker telephone exchange, which was recently destroyed by fire, will be rebuilt in the near future.

LAKOTA, N. D.—It is reported that a light and power plant will be erected in this place by a company organized in Morehead, Minn. A. M. Van Sickle is secretary and treasurer.

LA MOURE, N. D.—A franchise has been granted to B. N. Stone to install a telephone system in this territory.

WAHPETON, N. D.—Arrangements are being made by the Ottertail Power Company for the construction of its transmission line from its power plant at Dayton Hollow.

CINCINNATI, OHIO.—It is reported that the Cincinnati & Suburban Bell Telephone Company will increase its capital stock by $566,000. It is said the proceeds will be used for building conduits, erecting new pole lines and possibly establishing another substation at Avondale. The new stock will be allotted to present stockholders at par, one share of the new stock to each 24 shares of the old.

COLUMBUS, OHIO.—Business men of North High Street have purchased seven electric arches to be placed across the street between Vine Street and Buttles Avenue. They have asked the city authorities to pay for the energy that will be required to keep them lighted. If this is done, it will probably be furnished from the municipal plant.

COLUMBUS, OHIO.—The Columbus Railway & Light Company has connected the plants of the Public Service Company with the Columbus Edison plant, so that there may be an interchange of service. It is the intention to give the Yaryan heating system some time now and decide upon rates that will be fair to the company and the consumers. After this is done such extensions will be made as are found to be needed, although it has not yet been decided what the improvements will be.

LEBANON, OHIO.—The Valley Telephone Company of Warren County will take over the plant of the Bell Telephone Company and operate both plants as one system.

SMITHVILLE, OHIO.—The City Council has granted a franchise to the Wayne County Telephone Company to erect a telephone system in Smithville.

SPRINGFIELD, OHIO.—The City Council has granted a franchise to the Washington Traction Company for a term of 25 years.

WILMINGTON, OHIO.—The Cincinnati, Wilmington & Xenia Traction Company has petitioned the City Council for a franchise to operate its railway system through the city of Wilmington. The company proposes to build an electric railway to connect Blanchester, Martinsville, Wilmington, Port William and Xenia.

YOUNGSTOWN, OHIO.—The Mahoning Valley Street Railway Company has been granted a franchise for an extension of the Wick Avenue branch from its present terminus to the city limits.

MUSKOGEE, OKLA.—It is reported that the Pioneer Telephone Company will make extensive improvements to its system in Muskogee, which will involve an expenditure of $75,000.

PORTLAND, ORE.—Edwin G. Amme and associates have secured water rights on the Satiam River, aggregating 10,000 hp. It is proposed to incorporate a company under the name of the Central Oregon Power Company for the purpose of operating a hydro-electric plant, which will furnish electrical service to Lester and Quartzville mines, Salem, Albany and adjacent towns.

PANAMA.—Bids will soon be called by the Isthmian Canal Commission for furnishing one 75-kw, 125-volt, direct-connected generator unit.

PANAMA.—Bids will be received until Nov. 30 at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., for furnishing marine boilers, automatic water measuring tanks, oil filter, electric drills, condenser tubes, steel, copper, zinc, wire cable, metallic packing, etc. Blanks and general information pertaining to this circular (No. 478) may be obtained at the above office, or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

CHESTER, PA.—Joseph Shortledge, of Concordville, Pa., is reported to be interested in a project to construct an electric railway from Chester to Llewellyn, Concordville and West Chester.

DONORA, PA.—The contract for the construction of the Donora & Eldora Street Railway has been awarded to Frank Donatella, of Pittsburg, Pa. The railway will connect Eldora and Donora, and will be about four miles in length.

ELWOOD CITY, PA.—Plans are being made by the City Council for the construction of an electric light plant, bids for which will soon be called for. The cost of the plant is estimated at $11,000.

ERIE, PA.—Robert W. Watson, of Harrisburg, Pa., receiver of the Conneaut & Erie Traction Company, has asked for permission to issue $20,000 in bonds, the proceeds to be used for improvements to the system. R. W. Palmer, of Erie, is superintendent.

JOHNSTOWN, PA.—Bids will be received by George E. Hamilton, city clerk, until Nov. 25 for lighting the streets, alleys and public buildings with electricity for a period of both five and ten years from Jan. 1, 1909. The specifications call for about 500 arc lamps, furnishing and operating all incandescent lamps of 70 cp and meters. The City Council has rescinded the contract with the Citizens' Light, Heat & Power Company.

SMITHTON, PA.—The Borough Council has awarded a contract for the construction of an electric light plant in Smithton to DeCort Brothers, of Pittsburg, Pa. The cost of the plant is estimated at $20,000.

CEBU, P. I.—The Visayan Electric Company is making arrangements to increase the output of its electric plant by the installation of a 150-kw dynamo and will also install a 6-ton ice plant. R. R. Landon is secretary and general manager.

PONTIAC, R. I.—An electric light plant has been installed in the Pontiac Mills to furnish electricity to light the mills and bleachery. A larger dynamo will be installed later.

PROVIDENCE, R. I.—The stockholders of the Narragansett Electric Lighting Company have voted to issue debenture certificates to the amount of $500,000, the proceeds to be used to take care of the company's increasing business.

SENECA, S. C.—The citizens on Nov. 9 voted to issue $25,000 to construct an electric light plant and water works system. Dr. W. F. Austin is chairman public works.

CHATTANOOGA, TENN.—The Chattanooga-Tennessee River Power Company, which is constructing a hydro-electric power plant at Hale's Bar, will soon commence work on the construction of a substation in South Chattanooga which will be equipped with step-down transformers to reduce the voltage from 44,000 to 4000 volts. The transmission line from the power plant to the substation will be 17 miles in length. John Bogart is engineer.

ROGERSVILLE, TENN.—The electric plant of the Rogersville Electric Company is reported to have been destroyed by fire recently, causing a loss of about $5,000. The plant is to be rebuilt at once.

ALVIN, TEX.—The City Council has granted a franchise to E. B. Hill, of Alvin, to erect and operate an electric light plant for a term of 25 years. Under the terms of the franchise the plant is to be completed within one year.

CORPUS CHRISTI, TEX.—The Corpus Christi Gin & Milling Company would like to receive prices on a 75-hp motor.

DALLAS, TEX.—The city secretary will advertise for bids for lighting the streets of the city for a term of one to three years. The present contract with the Dallas Electric Light & Power Company expires Nov. 30.

GOLIAD, TEX.—It is reported that Shaper Brothers contemplate installing an electric light plant.

SAN ANGELO, TEX.—Arrangements are being made by the San Angelo Telephone Company to install exchanges at Fort Chadbourne, Mareta and Maryneil.

SHERMAN, TEX.—Contracts for equipment of the municipal electric light plant have been awarded as follows: For engine, generator, exciter and switchboard, to the Allis-Chalmers Company, for $7,451, and to the Western Electric Company, for 150 arc lamps, regulator and transformer, for $4,810. Henry Zimmerman is city secretary.

WALLIS, TEX.—The Austin County Telephone Company is in the market for telephone supplies and would like to receive prices on the same.

SALT LAKE CITY, UTAH.—Louis C. Kelly, city engineer, has submitted an estimate to the City Council of the cost of constructing an electric power plant at the north end of the Big Cottonwood conduit to operate the electric pump being installed in connection with the sewerage system. The cost of a 150-kw plant is estimated at $30,000; a 300-kw plant could be installed for $5,000 more. The annual cost of operating the 150-kw plant is placed at $9,000 and of the 300-kw plant at $10,000.

LYNDONVILLE, VT.—The citizens are considering the question of buying the interest of O. V. Hooker & Son in the water power at the municipal electric light plant.

RUTLAND, VT.—A bill has been introduced in the House of Representatives to incorporate the Otter Creek Electric Railway Company, which proposes to construct and operate an electric railway from Rutland through Clarendon, Wallingford, Danby, Mount Tabor, Dorset, Manchester, Sunderland, Arlington, Shaftsbury and Bennington.

DANVILLE, VA.—The contract for additional equipment to be installed in the municipal electric light plant has been awarded to the Allis-Chalmers Company. It includes a boiler, 500-kw turbo-generator set, etc. An appropriation of $22,000 has been made for improvements to the plant. F. Talbott is superintendent of the water, gas and electric light department.

NORFOLK, VA.—The contract for equipping the Sewell's Point Terminal of the Virginia Railway Company, to be operated by electricity, has been awarded to Smethurst & Allen, of Philadelphia, Pa.

BLAINE, WASH.—The City Council has granted a franchise to Joseph Morrison, A. J. Craven and J. W. Rose for the construction of a railway which will connect Bellingham with Sumas, Ferndale, Lynden and Dayton Harbor. The railway will be operated under the name of the Nooksack Valley Traction Company.

HUNTERS, WASH.—The falls at Hunters Creek have been purchased by J. C. Bowen, who will build a reservoir for irrigation purposes. The falls will also be utilized for power purposes.

NORTH YAKIMA, WASH.—W. F. Longmire has been granted a franchise by the County Commissioners to install a telephone system in the Selah and Wenas valleys.

NORTH YAKIMA, WASH.—The County Commissioners have granted a franchise to Robert E. Strahorn and the Yakima Electric Company to erect a high-tension transmission line from North Yakima to Kennewick to supply electricity for lamps and motors to the entire valley.

NORTH YAKIMA, WASH.—A company has been organized to build a telephone line from White Bluffs to Kennewick, Wash., a distance of 50 miles. Capital for building the telephone line will be furnished by the White Bluffs Land & Irrigation Company.

SEATTLE, WASH.—The Seattle Electric Company is planning to extend its transmission lines into the Rainer Valley.

SEATTLE, WASH.—R. S. Chapman is reported to be interested in a project to develop water power on the Dosewallips River. Mr. Chapman has obtained options from Henry Bucoy and associates, of Tacoma, on their properties in Jefferson County, and states that he has assurances of contract to furnish electrical energy at the Puget Sound Navy Yard. A submarine cable of high voltage will be installed to transmit electricity across Hood Canal. It is also planned to extend the transmission lines to Port Townsend, Wash.

SPOKANE, WASH.—The Interstate Telephone Company is planning to extend its telephone lines from Spokane to Lewiston next year.

SPOKANE, WASH.—Extensive improvements and extensions are contemplated by the Washington Water Power Company, which will involve a total expenditure of about $16,000,000, at the rate of $2,000,000 a year. A special meeting of the stockholders has been called for Dec. 1 to vote on the proposition to issue $15,000,000 in bonds. The capital stock of the company has been increased by $1,003,260. Henry M. Richards is president of the company.

SPRINGDALE, WASH.—John Kulzer, owner of the electric plant at Valley, 10 miles north of Springdale, is making arrangements to extend his transmission lines to this place, and, it is understood, will be ready to supply electricity for lamps within 30 days. The town now has a lighting system, but is unable to meet the demand for electric energy for lighting, owing to the lack of power.

SUMNER, WASH.—The Pacific Coast Power Company, of Seattle, Wash., is considering plans for the construction of a power plant between Sumner and Dieringer.

TACOMA, WASH.—The City Council is considering the question of erecting a power plant on the upper Nisqually River, where 20,000 hp can be developed. The cost of the plant is estimated at $2,000,000. The initial expense will be met by a bond issue of $300,000.

NORTHFORK, W. VA.—The Northfork Realty Company is reported to be interested in the construction of a proposed electric railway. Col. L. E. Tierney, of Powhattan, W. Va., is president of the company.

PARKERSBURG, W. VA.—Plans are being made by the Western West Virginia and other telephone companies to construct an independent telephone line from Parkersburg through to Athens and Pomeroy, Ohio. A. C. Davis is general manager of the Western West Virginia Telephone Company.

LA CROSSE, WIS.—William Neumeister and N. Haskell Withee, of La Crosse, Wis., are interested in a project to erect a water power plant, the cost of which is estimated at $250,000. Plans and specifications for the plant are being made by George Bradish, of La Crosse, engineer. The plant will be operated under the name of the La Crosse Water Power & Electric Company.

MADISON, WIS.—The question of installing an electric light plant to furnish electricity to light the municipal buildings is under consideration.

OSHKOSH, WIS.—The city is considering the question of installing an independent telephone system of its own.

LONDON, ONT., CAN.—The Southwestern Traction Company has petitioned the City Council for permission to extend its tracks along Simcoe to Talbot.

ST. CATHARINES, ONT., CAN.—The City Council has entered into a contract with the Lincoln Electric Light Company to light the streets of the city for a term of five years. The company is to furnish not less than 100 arc lamps at the rate of $50 per lamp per year. The city is to have the privilege of renewing the contract for a period of 15 years at expiration of the five-year contract.

MONTREAL, QUE., CAN.—The Montreal Light, Heat & Power Company has completed the Soulanges development and has announced that it proposes to commence work on the construction of an additional steam plant, which will have a maximum output of 100,000 hp. The new plant will be installed by units, and it is understood that the entire plant will be completed within two years.

CUERNAVACA, MEX.—E. Conas, of Cuernavaca, treasurer of the State of Morelos, is erecting an electric light and power plant in this city. The plant will have an output of 1600 hp and will furnish electricity to operate the street railway system, which is owned by Mr. Conas, and also for lamps and motors. The plant will be completed about Jan. 1.

GUADALAJARA, MEX.—George Mitchell and D. B. Russell, of New York, N. Y., are preparing to install a hydro-electric plant near Guadalajara to operate the machinery in their marble quarry. They also are planning to build an electric railway from their property to Guadalajara.

EBANO, MEX.—The Mexican Petroleum Company will install a hydro-electric plant in its oil field at Ebano, State of San Luis Potosi.

GUANAJUATO, MEX.—The Guanajuato Power & Electric Company, which operates a large hydro-electric plant at El Duro, State of Michoacan, and transmission lines to the Guanajuato mining district and to city of Guanajuato and to other industrial centers within a radius of 150 miles, is making important enlargements and improvements to its plant and system. Its new high-tension transmission line between Guanajuato and Penjamo will be finished by Jan. 1. The improvements at the various substation of the company will also be completed and ready for operation at that time. New oil switches for the new 60,000-volt transmission line are also being installed. George W. Bryant, of Colorado Springs, Col., and associates are interested in the enterprise.

MEXICO CITY, MEX.—The following applications have been made to the Mexican Government recently for concessions to install hydro-electric plants: Mariano Alcerreca and Jose Jijar y Harro, to erect a plant on the Santa Cruz and San Francisco creeks near El Monte; Guillermo Brockman, to erect a plant on the Turbio River, State of Guanajuato; Tezuitlan Mining & Smelting Company, to erect a plant on the Sola River, State of Oaxaca; Isidro Medina, to erect a plant on the Ameca River, near Ameca, State of Jalisco; General Mariano Ruiz, to erect a plant on the Alica River, Territory of Tepic; Gill S. Peyton, to erect a plant on the Lerma River, State of Jalisco; Armado I. Santa Cruz, to erect a plant on the Huitzilapam River, State of Puebla.

TAXCO, MEX.—An electric power and lighting plant has just been installed near Taxco, State of Guerrero, by the Compania Minera y Metalurgica. The plant will furnish electricity to operate the machinery of the mines of the company.

Company Elections.

BUFFALO, N. Y.—The shareholders of the Niagara, Lockport & Ontario Power Company have elected the following directors for the ensuing year: H. H. Westinghouse, George C. Smith, Paul T. Brady and Charles A. Tarry, of New York, N. Y.; William Hamlin, Terry Greene, S. M. Clement and William H. Gratwick, of Buffalo, and H. D. Uptegraff, of Pittsburg, Pa.

New Industrial Companies.

THE MILLER ENGINEERING COMPANY has filed articles of incorporation with the Secretary of State at Dover, Del. The incorporators are F. R. Hansell, G. H. B. Martin and S. C. Seymour, of Philadelphia, Pa.

THE CALORIFIC BOILER COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $100,000. The diretcors are: James Walp, of Allentown, Pa.; N. P. Kennison, of Reading, Pa., and Thomas K. Lemon, of New York, N. Y.

THE BALANCE-PRESSURE ROTARY ENGINE COMPANY, of Buffalo, N. Y., has been chartered, with a capital stock of $50,000, to manufacture a rotary engine, invented by William M. Hoffman. The company has secured quarters in the Day Manufacturing Building, Buffalo.

THE SMOKELESS HEAT & POWER COMPANY, of Cleveland, Ohio, has filed articles of incorporation, with a capital stock of $500,000, for the purpose of placing on the market a new apparatus for the conversion of crude oil into heat and power. James W. Keenan and others are incorporators.

THE ELECTRIC METALS COMPANY, of Philadelphia, Pa., has been chartered, with a capital stock of $30,000, to produce lead under a new process for journal bearings and for making type. The officers are: A. S. Dickinson, president and general manager; W. Akimoff, secretary; H. H. Sturch, treasurer, and S. P. Hutchinson, metallurgist.

New Incorporations.

GADSDEN, ALA.—The Alabama Power Company has been incorporated, with a capital stock of $5,000, by W. P. Lay, Earl Lay and W. R. Hood. The company proposes to furnish electricity for lamps and motors in Gadsden, Anniston, Birmingham, Bessemer and other cities.

EATONVILLE, GA.—Articles of incorporation have been filed for the Eatonville Telephone Company, with a capital stock of $6,000, by John G. Spivey, Henry D. Spivey and John C. Spivey.

NASHVILLE, GA.—The Nashville Telephone Company has been incorporated, with a capital stock of $8,000, by F. L. Sweet, J. M. Dent, Joseph A. Alexander and J. D. Lovett.

CHICAGO, ILL.—The Chicago, Joliet & Western Interurban Company has been chartered, with a capital stock of $10,000 and the following directors: C. Fox, Andrew Rutledge, Jr., Frances E. Hinckley and Stephen A. Cross, all of Chicago, Ill. The company proposes to construct an interurban railway from Chicago through Cook and Dupage counties, another from Chicago to Joliet, and another from Chicago west to different points in the counties of Kendal, Grundy and La Salle, as may be agreed upon.

ATLANTA, IND.—The Auroma Farmers' Telephone Company has filed articles of incorporation with the Secretary of State. Henry Carpenter, J. G. Swift and S. E. Billrymer are the directors.

GARY, IND.—The Gary, Hobart & Valparaiso Traction Company has filed articles of incorporation. The capital stock is placed at $10,000. The object of the corporation is to construct and operate an electric road from Gary to Valparaiso via Hobart and also a street railroad in the city of Gary. Jas. S. Hopkins and H. W. Watkins, of Chicago; Francis Y. Keaton, Aurora, Ill., and H. C. Davis, Evanston, Ill., are directors.

PERKINSVILLE, IND.—The Farmers' Telephone Company of Perkinsville has been organized and has already closed a deal with a Chicago concern to construct an exchange, install a switchboard and build lines to Franklin, New Lancaster, Noblesville and Elwood. Arrangement has also been made to connect with the Central Bell Telephone Company for toll line service. Charles Harvey, of Elwood, is president, and F. E. Haworth, secretary.

SADLER, KY.—The Barren Creek Telephone Company has been formed by K. G. Sadler, Hiram Sadler and Samuel Pense. The company is capitalized at $1,300, and proposes to construct a local telephone system and to erect a telephone line to Martin's, via Bend, a distance of about 13 miles. Samuel Pense is manager.

VANCEBURG, KY.—Articles of incorporation have been filed for the Burtonville, Esculapia Springs & Vanceburg Telephone Company by Charles M. Beach, W. B. Cropper and Clarence E. Cropper.

GREEN RIDGE, MO.—Articles of incorporation have been filed for the Green Ridge Telephone Company, with a capital stock of $2,000, by W. A. Sanders, W. T. Brim and others.

OMAHA, NEB.—The Nebraska Power Company has filed articles of incorporation with the Secretary of State in Delaware. The company is capitalized at $12,000,000 and proposes to develop water-power to generate electricity for eastern Nebraska cities.

PIOCHE, NEV.—The Pioche Electric Light & Power Company has been organized, with a capital stock of $75,000, to construct an electric light plant, for which the equipment has already been ordered. The cost of the plant is estimated at $187,500. The officers are: W. B. MacSherry, president and manager; E. F. Freudenthal, vice-president, and H. E. Freudenthal, secretary.

BABYLON, N. Y.—The South Bay Electric Company has been incorporated, with a capital stock of $10,000 and the following directors: Thomas A. Eager, of New York, N. Y.; A. B. Pearce, of Long Branch, N. J., and Walter H. Elleser, of Tappan, N. Y.

PITTSBURG, PA.—The Pan Handle Electric Company has been incorporated, with a capital stock of $80,000, by Joseph Bryan, S. M. Dunbar and J. I. Merrill, of Pittsburg, Pa.; H. R. Randolph, of Suter Station, Pa.; Armor S. Cooper, of New Cumberland, W. Va. The company proposes to build an electric interurban railway from Pittsburg and Carnegie

and Chester, thence down the West Virginia side of the Ohio River to Wheeling, W. Va.

MERCEDES, TEX.—Articles of incorporation have been filed for the Mercedes Electric Light Company by Winfield S. Chaplin, Arthur E. Chapman and William J. De Force. The capital stock of the company is placed at $2,000.

HORTON'S SUMMIT, VA.—The Horton's Summit Telephone Company has been incorporated, with a capital stock of $2,500, by George D. Smith, Felix Maggard and Thomas King. The company proposes to construct a telephone line from Horton's Summit, via Fort Blackmore and Duffield, to Turkey Cove, also to maintain a local system in and around Horton's Summit. Thomas King is manager.

RICHMOND, VA.—The Richmond, Urbanna & Peninsular Railway Company has filed articles of incorporation for the purpose of constructing an interurban railway connecting West Point, Urbanna and other places. The length of the railway, including branches, will be 116 miles. Surveys have been completed, but the contract will not be awarded until all the right of way is secured. The capital stock of the company is placed at from $100,000 to $500,000. The officers are: John C. Robertson, president; Boyce D. Brooker, vice-president, both of Richmond, Va.; James Taylor Robertson, of Richmond, Va., secretary, and George C. Bland, of Shacklefords, Va., treasurer.

SEATTLE, WASH.—The Coast Lighting Company has been incorporated, with a capital stock of $25,000, by George L. Grant, C. F. Pennewell and others.

SEATTLE, WASH.—Articles of incorporation have been filed for the Seattle & Issaquah Electric Railway Company by Edwin S. Gill and John McQuade. The company is capitalized at $2,000,000.

HARTFORD, WIS.—The Hartford Rural Telephone Company has been organized, with a capital stock of $1,500 and the following-named officers: E. M. Anderson, president; Daniel Schultz, vice-president; A. W. Brown, secretary, and Michael Reik, treasurer.

Legal.

RECEIVER FOR TELEPHONE COMPANY.—Judge Walter Evans, of the Federal Court of Western Kentucky, has appointed Col. J. D. Powers as receiver for the Kentucky & Indiana Home Telephone Company, of Owensboro. J. W. Slaughter is president of the company and K. C. Jones general manager.

WIRELESS LITIGATION.—The Radio-Telephone Company, of New York, which is the De Forest concern, filed a bill in the United States Circuit Court in Trenton last week asking for an injunction restraining the Collins Wireless Telephone Company of Newark from infringing on patent rights granted to John Stone, of Cambridge, Mass., for wireless telephones, known technically as "space telephones." The Radio-Telephone concern also asks an accounting. The De Forest company is operating under the patents granted to Mr. Stone. These patents, it asserts, cover the entire field of wireless telephony. There was a business show in Newark recently. At that time the Collins company, according to the officials of the Radio company, gave demonstrations to interest investors in the stock. James Dunlop Smith is president of the Radio company. The Collins system was also shown at the recent Electrical Show in New York.

Obituary.

MR. H. D. HALE.—The death occurred last week in New York of Mr. Herbert D. Hale, son of the Rev. E. E. Hale, chaplain of the United States Senate. As a young architect—being only 42 years of age—Mr. Hale had already made a considerable reputation. The firm of Hale & Morse were architects of the Engineering Societies Building, one of the finest pieces of architecture in New York City, and after its construction Mr. Hale found himself in ill health, from which he never recovered. He was a graduate of Harvard and of the Beaux Arts, Paris. During the four years of work on the Engineering Building he made a great many friends and acquaintances in the engineering profession.

Personal.

MR. G. MARCONI.—According to advices from Europe, it has been unofficially stated at Stockholm, Sweden, that Mr. G. Marconi will receive the next Nobel prize in physics for his work in wireless telegraphy.

MR. C. A. SCHIEREN is the subject of a good portrait and an excellent biographical sketch in the bulletin of the Brooklyn Institute for Nov. 14, with which he has been actively and prominently connected for 20 years.

MR. HOMER NIESZ.—Owing to the illness of Mr. Homer E. Niesz, managing director of the Chicago Electrical Show in January, Mr. J. J. Schayer, of the Commonwealth Edison Company, will take charge of the management of the show until such time as Mr. Niesz may be able to resume his duties.

MR. C. F. McGILVRAY, president of the Robbins & Myers Company, of Springfield, Ohio, sailed last Saturday for Europe on the *Arabic*, White Star steamer, to be gone about four weeks. He will visit London, Paris, Berlin and other cities in the interest of his progressive and growing company.

MR. HARVEY F. PEARCE, who has been superintendent of the municipal electric light plant at Negaunee, Mich., since 1905, has resigned to accept the position of superintendent of the Twin City General Electric Company, which operates the street railway systems and electric lighting plants at Ironwood, Mich., and Hurley, Wis.

MR. J. R. GORDON, for many years Southern district manager for the Westinghouse Electric & Manufacturing Company, has resigned from that company and accepted a position with the Western Electric Company as power apparatus sales manager for their Southern territory, with headquarters at Atlanta. He took charge of his new duties on Nov. 1.

MR. BURDETT LOOMIS, JR., has opened a sales office in the Connecticut Mutual Building, Hartford, Conn., where he will look after the interests of the Power & Mining Machinery Company, builders of the Loomis-Pettibone gas producers, and of the Snow Steam Pump Works, of Buffalo, N. Y., builders of the Snow horizontal, double-acting gas engines in all sizes.

MR. W. M. McFARLAND, vice-president of the Westinghouse Electric & Manufacturing Company, has written an admirable memoir, in brief, of his old friend, Mr. W. H. Bailey, a leader in the brass and copper tube industry and a man who was keenly interested in American technical and engineering development. Mr. Bailey was also one of the oldest clubmen in New York and an active member of the Engineers' Club.

MR. L. A. FERGUSON, president of the American Institute of Electrical Engineers, had a fortunate escape on Nov. 11 while on his way from Chicago to preside at the monthly meetings in New York. His train, the Twentieth Century Limited, struck a broken rail near Rochester and three sleepers derailed. Mr. Ferguson got off with a few bruises and was able to attend to his official duties on arrival. Mr. J. F. Gilchrist, who was with him, did not get any hurt at all.

MR. W. D'A. RYAN, illuminating engineer of the General Electric Company, addressed the electrical section of the Western Society of Engineers at Chicago, Nov. 13, on "Recent Developments in Artificial Illumination." Mr. Ryan's address, which was profusely illustrated with lantern slides, dealt mainly with designs of tungsten cluster fixtures for the lighting of large areas. He also illustrated the arc-lighting appliances for the indirect lighting of the new Union Station at Washington, D. C.

MR. WALTER B. SNOW, of Boston, has been appointed a member of the Massachusetts Commission for the Blind. Mr. Snow is a graduate of the Massachusetts Institute of Technology and is president of the Alumni Association of the institute. Mr. Snow has been an instructor at the institute, is a trustee of the Watertown Public Library, member of the American Society of Mechanical Engineers, the Twentieth Century Club, the Industrial League and the Society for the Promotion of Engineering Education. For several years he was on the staff of the B. F. Sturtevant Company, and is now engaged in business as a publicity engineer.

Trade Publications.

SANGAMO ELECTRIC COMPANY, Springfield, Ohio, has issued its Bulletin No. 12, for November, devoted to its Sangamo wattmeters, type D, direct current, and type F, alterating current. The apparatus is very fully illustrated and described, all parts being shown in great detail.

STERLING ELECTRIC MOTOR COMPANY, of Dayton, O., is issuing in handsome embossed cover in colors some excellent statistical data as to its various types of generators and motors, turbo-generators, single-phase and polyphase motors, etc. The apparatus is very fully illustrated and dimension diagrams are given.

MULTIPLE-SPINDLE DRILLS.—The Pratt & Whitney Company, Hartford, Conn., has issued an elaborately illustrated catalog devoted to a line of drilling machines adapted for various classes of work. The drills are useful in the manufacture of dynamo-electric machinery, while they are well suited for operation by electric motors.

WESTINGHOUSE LAMPS.—The Westinghouse Lamp Company, Bloomfield, N. J., has just issued Form 1200, which covers net prices and sales conditions in regard to all types of its incandescent lamps. The fullest details are given as to all rules and schedules, free delivery points, etc. A recent distribution of this booklet has been made to all Westinghouse jobbers.

CENTRAL ELECTRIC PRICE LIST.—This company has issued a special November price list which supplements the September list and applies to the company's 1909 general catalog. On the front page of the list the company calls special attention to the fact that it is carrying in the Chicago warehouse a large stock of tungsten lamps and Pittsburg transformers and is prepared to make prompt shipment of all supplies.

ROLLINSON ELECTRICAL SPECIALTIES.—The Mohawk Electric Company, Albany, N. Y., with factory at Guelderland, N. Y., has issued a pamphlet on its Rollinson electrical specialties, including the alternating current bell ringer and the direct current type; telephone bell ringer, small transformers, diagnostic lamp transformers, iron service or entrance boxes. All are illustrated and fully described. The company is putting on the market a new device for testing watt-hour meters.

ROLLER BEARINGS.—The Standard Roller Bearing Company, Fiftieth Street and Lancaster Avenue, Philadelphia, has just issued a four-page circular calling attention to its facilities for production on a large scale, and notes the fact that its experience has been gained in supplying over

1,000,000 bearings of various types. It makes over 50 types of ball and roller bearings.

POLYPHASE MAXIMUM WATT DEMAND INDICATOR.—Bulletin No. 4622, issued by the General Electric Company, is devoted to a description of its Type W, Polyphase Maximum Watt Demand Indicator. This instrument is suitable for recording the maximum load on alternating-current circuits, irrespective of power factor and voltage fluctuations. As it indicates the actual watt consumption, it is especially adapted for motor installations. These indicators are made self-contained in capacities of from 25 to 150 amp, 220 to 650 volts.

DIRECT-CURRENT SWITCHBOAD PANELS manufactured by the Crocker-Wheeler Company, Ampere, N. J., are described in Bulletin No. 106, recently issued. This bulletin has illustrations of a large number of standard panels that can be assembled together to form a switchboard of any size. The bulletin contains valuable suggestions as to the instruments and apparatus necessary on switchboards.

Business Notes.

THE NORTHERN ENGINEERING WORKS, crane builders, Detroit, have changed the location of the Chicago branch office from 405 Monadnock Block to 539 Monadnock Block, with Mr. B. C. Wolcott in charge as formerly.

THE DEL SALES COMPANY, Chicago, has moved its main office from the sixth to the second floor of the Monadnock Block, where office room proportionate with the company's increased sales of the Del electric curling irons is obtained.

THE JENNEY ELECTRIC MANUFACTURING COMPANY, of Indianapolis, Ind., has increased its capital stock from $450,000 to $600,000. Its place of business and the manufacturing plant will be removed from Indianapolis to Anderson.

WIZARD VIBRATOR.—The Metropolitan Electrical Supply Company, 184 Lake Street, Chicago, is making a specialty of the Wizard vibrator and is now pushing the sale very vigorously. It weighs only 1¼ lb. and works equally well on direct and on alternating current, 110 volts.

NORTHERN ENGINEERING WORKS.—Northern Engineering Works, Detroit, Mich., has recently completed an installation in the plant of the Penn American Plate Glass Company, of Alexandria, Ind. There are five cranes of three motors each, four being a 65-ft. span and one a 30-ft. span.

MATHIAS KLEIN & SONS, Chicago, report that the Quick Samson grip, designed for handling messenger wire, has met with deserved success since it was placed on the market a few months ago. The firm has sent out a number of the clamps on approval and has received some good testimonials of their serviceable qualities.

THE WILLARD STORAGE BATTERY COMPANY, of Cleveland, has opened an office and battery depot at 1876 Broadway, corner Sixty-second Street, New York City. At this point it will keep all kinds of batteries and parts in stock. Orders for batteries and parts for New York and vicinity will be assembled at this depot, which will insure prompt service and quick deliveries.

PROTECTUS COMPANY.—Mr. C. H. Spotts, formerly manager of the paint department of the Joseph Dixon Crucible Company, New Jersey, and Mr. W. F. Swearer, assistant, are now associated with the Protectus Company, paint makers, of which Mr. Spotts becomes secretary and Mr. Swearer, New York manager. Protectus paints have been successfully used for some years by railroads, etc.

THE VULCAN ELECTRIC HEATING COMPANY, Chicago, reports that many of the manufacturers of electrical apparatus throughout the United States are obtaining gratifying results from the use of the company's electrically heated soldering tools. The interchangeable tip of these tools makes it possible to use the same heating element for stamping furniture and tool handles, for branding stock and for a variety of other purposes as well as for soldering.

JOHN A. ROEBLING'S SONS' STEEL WIRE.—The John A. Roebling's Sons Company is having marked success with its steel wire for suburban trolley purposes. This new product is being used more liberally every day and is standing all sorts of tests successfully. It is much less expensive, of course, than copper wire and this is one of its chief advantages for suburban trolleys. It has been extensively used on certain sections of the New York, New Haven & Hartford Railroad and it is claimed has been absolutely satisfactory.

WESTERN ELECTRIC COMPANY.—The Western Electric Company has recently installed a new central energy switchboard at Vallejo, Cal., for the Pacific Telephone & Telegraph Company and the local *Evening Chronicle* devotes two columns to enthusiastic praise of the board and the "cutting over" of the system to it. The paper makes also an excellent epitome of the various advantages attached to a good telephone system, both for the citizens of the community served, the country surrounding and all the various municipal departments such as fire, water, education, police, etc.

WEIGHT COMPUTER.—The Edge Computer Sales Agency, St. Paul Building, New York, is marketing a mechanical device for calculating the weight of all structural shapes of any length. It consists of two disks, one rotating concentrically over the other, each disk being marked with logarithmic scales representing the dimensions in feet and inches of the various shapes and the results in pounds. The device is useful to engineers in general, draftsmen and others in computing the weights of steel shapes for any purpose, and it gives results accurate within a very small percentage.

WESTINGHOUSE CHRISTMAS BOX.—The Westinghouse Electric & Manufacturing Company has made up a line of Christmas packages, containing useful electrical appliances. The packages are wrapped in holly paper and tied with red ribbon and then rewrapped with transparent paper through which the colors are visible. Such articles as sewing machine motors, sad irons and electric hot plates or stoves in two sizes are put up in this manner. Each package carries an appropriate card and label conveying the wishes of the season and provided with a space in which the donor may write his name and the name of the party for whom the package is intended.

LORD ELECTRIC COMPANY.—At this time the Lord Electric Company, 213 West Fortieth Street, New York City, actually finds itself behind orders. Orders have been coming in so briskly of late that it has not been able to turn out the material fast enough to meet the demands. The business during the last 90 days has shown a wonderfully marked increase. It has received orders from South America, England, Philippine Islands and from nearly every section of the United States for lightning arresters, Earll trolley retrievers and catchers, choke coils, disconnecting switches, and it now has on its books a pleasing number of goodly sized orders for other specialties.

THE WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., has developed its resistance unit with Edison base mounting, suitable for mounting in lamp socket. The porcelain tube on which the wire is wound is continuous. It is threaded at the base to receive the brass screw terminal. The completed unit is straight, and the head is arranged with a recess in which a small brass number plate is inserted, on which the resistance is marked. This tube has 50 watts capacity and can be wound with any resistance up to 1500 ohms. Resistance lamps have been used in many laboratories and telegraph exchanges in the past, but have the disadvantage that the resistance alters and ages and that they occupy considerable space and are costly. This tube is of the standard Ward Leonard type; the wire has a zero temperature coefficient and is protected from electrical, chemical and mechanical depreciation. Any size Ward Leonard tube up to 200 watts capacity can be mounted in this same manner.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 10, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

903,164. ELECTROLYTIC APPARATUS; Paul Borgnet, Liege, Belgium. App. filed May 11, 1907. Electrolytic apparatus adapted to employ currents of high density by reason of the fact that the electrolyte moves rapidly with respect to the cathode. The latter is alternately immersed in and caused to emerge from the electrolyte as the result of a rotative movement.

903,165. THERMOSTATIC CIRCUIT CONTROLLER; George H. Bowen, Boston, Mass. App. filed June 20, 1907. A thermostatic circuit controller having a glass top within which the operative parts of the circuit controller are located and sealed against atmospheric influence.

903,177. SYSTEM FOR CONTROLLING ONE OR MORE ELECTRIC MOTORS; Henry H. Cutler, Milwaukee, Wis. App. filed Aug. 11, 1905. A multiple unit control system for trains having a plurality of solenoid switches or contactors which are controlled directly by variations of voltage upon the controlling circuit of the train.

903,178. SYSTEM FOR CONTROLLING ONE OR MORE ELECTRIC MOTORS; Henry H. Cutler, Milwaukee, Wis. App. filed Aug. 11, 1905. Relates to modifications of the above.

903,193. SYSTEM OF CONTROL; Ray P. Jackson, Wilkinsburg, Pa. App. filed May 8, 1905. A controller system for train motors having motors to operate the controllers and operating circuits, including specially arranged transformer windings.

903,195. TESTING GALVANOMETER; Harry T. Johnson, New York, N. Y. App. filed March 22, 1906. The galvanometer has a magnetic needle, an electromagnet disposed below the same, and means for adjusting the magnet.

903,197. TELEPHONE TRANSMITTER; William Kaisling, Chicago, Ill. App. filed March 15, 1906. A telephone transmitter comprising substantially a plane sound-receiving diaphragm fixed at its center, a granule chamber mounted thereon, co-operating electrodes within said chamber, and a body of granular resistance varying material between said electrodes.

903,221. OUTLET BOX COVER; George B. McBean, Chicago, Ill. App. filed Feb. 23, 1907. An oulet box cover for electric light installations of the type in which a metal cover is directly combined with a porcelain socket for receiving a screw-threaded base of an incandescent lamp. Has a convenient fastening between the cover and the socket.

903,251. CIRCUIT CLOSING DEVICE; Alfred A. White, Bangor, Me. App. filed May 18, 1907. A clock mechanism includes a segment wheel and a pallet in an electric circuit, the ends of the pallet being

adapted to contact with the segment, said ends and the ends of the segment being offset so that each end of the pallet contacts with a separate set of segments.

903,257. CONTACT OILER; Albert D. Wiswall, Utica, N. Y. App. filed June 12, 1907. A means for oiling the contact plates of a controller and including a cylindrical roll analogous to an ink roller in a printing press.

903,288. MOTOR CONTROLLING SYSTEM; Clark T. Henderson, Milwaukee, Wis. App. filed March 14, 1907. Means for automatically controlling electric motors of the type which operates centrifugal pumps and the like. The motor is automatically started and stopped in accordance with the pressure of the water attained in the reservoir. Has a float-operated switch.

903,319. THERMOSTAT FOR ELECTRIC HEATERS; Earl H. Richardson, Ontario, Cal. App. filed Jan. 2, 1908. A flatiron is made hollow and contains a pair of resistance elements and a thermostat, the operation of which can be regulated by an adjusting screw which projects outward through the casing.

903,338. CONTROLLER CONSTRUCTION; Emmet W. Stull, Norwood, Ohio. App. filed March 31, 1906. A construction of controller having a blow-out magnet, a cylinder with drum contacts, and a shaft supporting said cylinder but insulated therefrom, said shaft and cylinder being of magnetic material and forming part of the magnetic circuit or said blow-out magnet.

903,348. CONTROLLING APPARATUS; Albert G. Wessling, Norwood, Ohio. App. filed Dec. 9, 1907. A controller for hoisting mechanism adapted to operate at a distance from a limit of movement which is a function of the power supplied by said motor to the hoisting mechanism.

903,366. TROLLEY POLE; Seybert D. Fenimore, Folcroft, Pa. App. filed Dec. 4, 1907. The trolley pole is made with a jointed upper section with connections to the operating cord of such a character that the pole is locked against further upward movement whenever there is relative movement of said upper pole section due to the wheel leaving the trolley wire.

903,383. ELECTRODE FOR ARC LAMPS; Franz Janecek, Karlin, near Prague, Austria-Hungary. App. filed May 16, 1907. A lamp electrode of the type having pins or stops which permit its descent when melted. The pins are made of a ladder-shaped metal strip doubled upon itself and inserted in a groove of the electrode.

903,404. METHOD OF SEPARATING ELECTRO-DEPOSITED METALS FROM LEAD MATRICES; Charles Reverdys, New York, N. Y. App. filed Dec. 25, 1907. A method of treating the surfaces of a lead matrix with a blast of carbonic acid previous to the deposition of copper thereon and which permits the withdrawal of the matrix from the copper deposit.

903,414. COMBINED SIGNAL AND SPEED CONTROLLING MECHANISM FOR RAILWAY TRAINS; Jens G. Schreuder, Edgewood Park, Pa. App. filed Aug. 3, 1907. Means for automatically controlling the positions of the track trips or stops, and also signal mechanism actuated in connection with the track trips or stops.

903,415. COMBINED SIGNAL AND SPEED CONTROLLING MECHANISM FOR RAILWAY TRAINS; Jens G. Schreuder, Edgewood Park, Pa., and Vibe K. Spicer, Chicago, Ill. App. filed Aug. 3, 1907. Relates to additional features of the above.

903,547. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed June 29, 1903. In a telephone system, the combination with a telephone circuit of a common source of current at the central office, an electromagnet mechanism including two magnet coils both operable over circuits including portions of the talking circuits, one of said coils being energized to attract its armature and the other coil being energized at another time to attract its armature, the latter armature being operated against the force of said first-mentioned coil, both of said coils receiving current simultaneously from said common source, and telephone apparatus controlled by said armatures.

903,552. LIFTING MAGNET; Arthur C. Eastwood and Frederick R. Fishback, Cleveland, Ohio. App. filed April 4, 1908. A motor hoist for a traveling crane, including a lifting magnet having its winding adapted for operation in series with one or more of the motors.

903,561. TELEPHONE SYSTEM; Joseph A. Geller and Stephen H. Geller, Chicago, Ill. App. filed Nov. 4, 1907. In combination with a telephone circuit, a controlling mechanism comprising stationary and movable contacts for the signaling, operating and talking circuits, an electro-responsive actuating means for the controlling mechanism included in an operating circuit, a releasing means for the controlling mechanism, and a magnet therefor in a circuit not controlled by said controlling mechanism.

903,568. ELECTRICAL CONTACT MAKER; John Harry Hart, Memphis, Tenn. App. filed Jan. 20, 1908. A laterally movable spring arm projects across the path of the trolley wheel so as to provide a temporary electrical connection during the passage of the wheel.

903,577. ELECTRIC FLOOR PUSH-BUTTON; Henry Francis Keil, Bronxville, N. Y. App. filed March 2, 1908. A floor push-button of the type having an insulating block with a pair of spring blades and a centrally guided plunger which engages said blades.

903,580. ELECTRIC CURRENT REGULATOR; David R. Knapp, Philadelphia, Pa., and Howard E. Cade, Pencoyd, Pa. App. filed May 29, 1907. Specific details of a charging system for storage batteries and adapted to close the charging circuit whenever the voltage on the charging source is sufficiently high to allow a charging current to flow. Has means for giving an alarm and other features.

903,640. ELECTROMEDICAL APPARATUS; Reinhold H. Wappler, New York, N. Y. App. filed Dec. 30, 1907. Has a coil and means for taking a sinusoidal shunt current from said coil and means for interrupting the current. Includes a clock mechanism which swings an arm forward and back to cut windings in and out of the coil.

903,692. FEED WIRE INSULATOR; George M. Finckel, Columbus, Ohio. App. filed May 20, 1908. A grooved cylindrical porcelain insulator has a specially formed central recess co-operating with a form of metal pin so as to be locked thereto by a predetermined manipulation.

903,698. TROLLEY WHEEL; Edmund J. Fredericks and Dilla R. Fredericks, Ohio, Ill. App. filed Sept. 27, 1907. The trolley wheel is mounted on a bushing with a spirally cut groove which communicates with cavities in the harp and which supplies oil to the bearing surfaces.

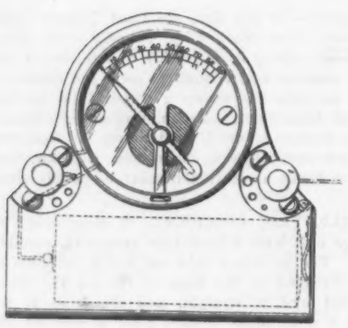
903,705. ROTARY SNAP SWITCH; Gilbert W. Goodridge and George B. Thomas, Bridgeport, Conn. App. filed Jan. 3, 1908. The switch blades are restrained against movement by a detent which is impelled axially by a threaded engagement with the spindle so as to permit rotative movement of the switch element under the spring pressure.

903,745. INTERRUPTER; Carl E. Pearson, Lansing, Mich. App. filed July 10, 1907. A form of circuit interrupter for ignition systems designed to avoid the use of a heavy armature and the necessity of creating a magnetic field at each break of the circuit. Has a special arrangement of conductors for producing the magnetic field which moves the interrupter.

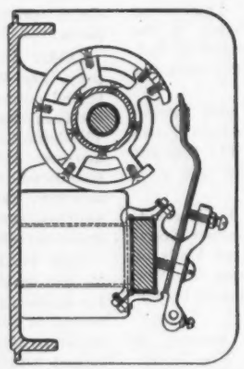
903,752. PROCESS OF FORMING PLATES FOR STORAGE BATTERIES; William Morrison, Chicago, Ill. App. filed Dec. 26, 1902. Provides a process for forming storage battery plates by which no objectionable gases or fumes will be given off.

903,768. SIGN RECEPTACLE; Clarence D. Platt, Bridgeport, Conn. App. filed Dec. 12, 1907. A receptacle of the type adapted to fit in a perforation of a metal plate and to be firmly contained therein. An insulating bushing which screws on the threaded shell constitutes a clamping nut to hold the receptacle in place.

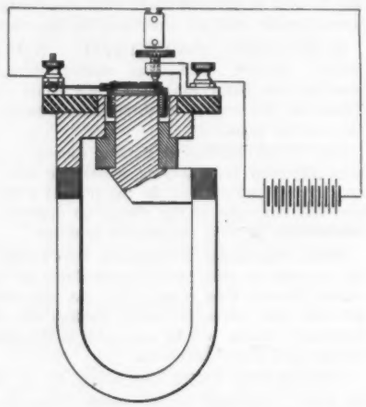
903,785. SIGNAL SYSTEM; John J. Ruddick, Newton, Mass. App. filed May 23, 1908. A complete signal system which will not be disabled by lightning, cross wires or similar causes. Has means by which the wire or wires which connect the two signal boxes at opposite ends of a block are normally disconnected from the ground, so that under normal conditions there is no ground connection at either box which could form a possible path for a lightning discharge.



903,195—Testing Galvanometer.



903,338—Controller Construction.



903,745—Interrupter.

903,791. DOUBLE POLE ELECTRIC CIRCUIT BREAKER; William Harding Scott, Norwich, England. App. filed July 24, 1908. A double pole circuit breaker in which the switches operating the main currents are at opposite ends of an electromagnetic system. The sparking points of the switches are arranged in separate compartments so that flashing over from one pole to another is prevented.

903,796. ELECTRIC BLOCK SIGNAL SYSTEM; Paul J. Simmen, Oakland, Cal. App. filed Jan. 28, 1907. A system for use in connection with an electric railroad operated by continuous current so that the return circuit for the car current passes through both rails of the track.

903,799. STORAGE BATTERY; John L. Smith and Malcom O. Smith, Cleveland, Ohio. App. filed July 20, 1908. A storage battery of the cell type having two elastic, non-conducting frames in which the edges of the plates are seated, and a mud-guard frame of non-elastic, non-conducting material clamped between the plate-holding frames.

903,807. ADJUSTABLE SUPPORT FOR ELECTRIC WIRES; Albert W. Bensley, Pawtucket, R. I. App. filed Sept. 15, 1908. A fixture or casting is adapted to be bolted to the side of a wheel and has star-shaped recesses in which insulators may be received and locked at different angles.

903,811. RELAY FOR REINFORCING SOUND; Jens H. Christensen, Sovejen, Tollerod, Denmark. App. filed March 30, 1905. A telephone relay comprising a diaphragm, a pendulum depending adjacent thereto and having a contact bearing against said diaphragm, said pendulum being supported by jewel bearings comprising a mercury contact for conducting current through the pendulum.

903,812. ELECTRICAL PROTECTIVE APPARATUS; Frank B. Cook, Chicago, Ill. App. filed March 8, 1906. Protective apparatus comprising a thermal protector and a plurality of conducting rods associated therewith, means for operating the protector upon abnormal current conditions, and a circuit-controlling member for engaging the said rods upon the operation of the protector.

903,813. CONTACTLESS THERMAL PROTECTOR; Frank B. Cook, Chicago, Ill. App. filed April 12, 1907. Details of soldered connection between thermal cartridge and its spring blade supports.